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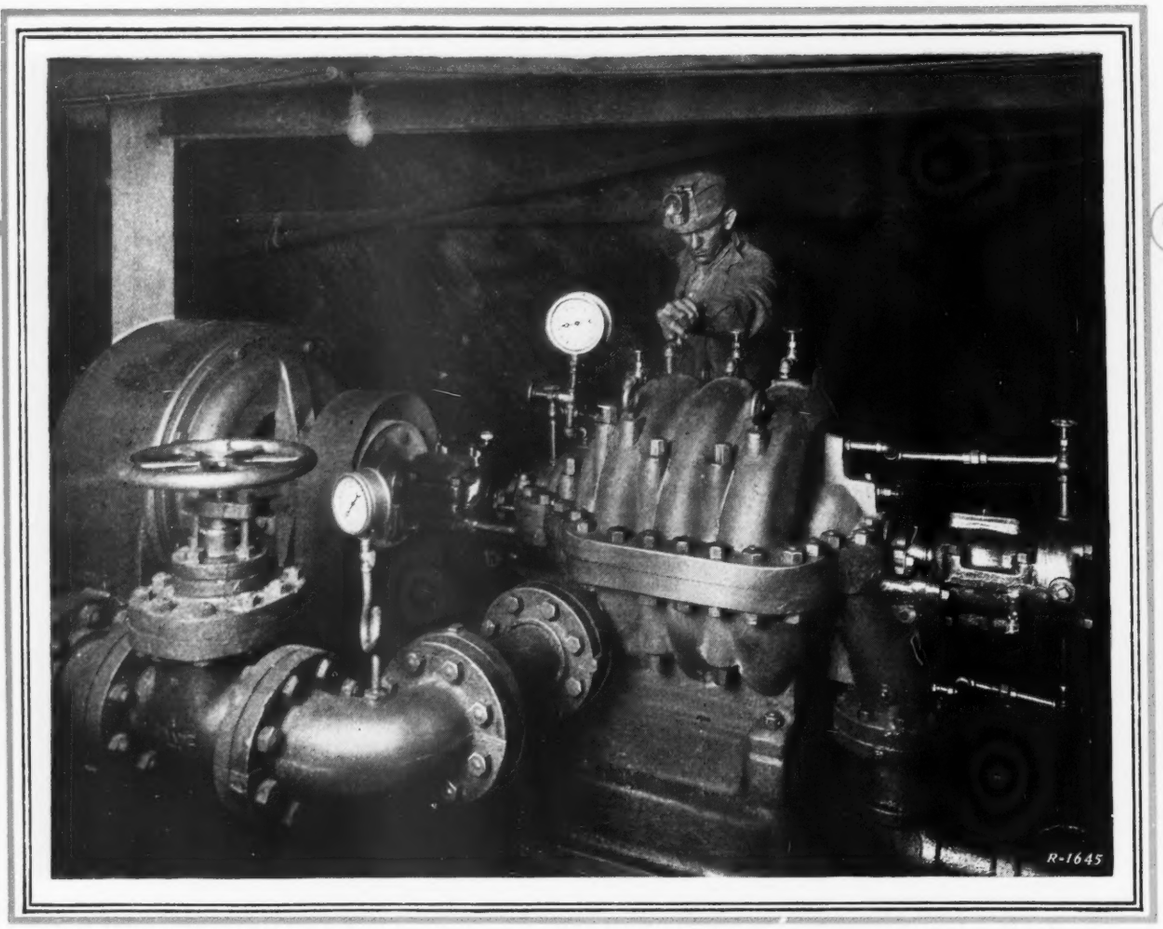

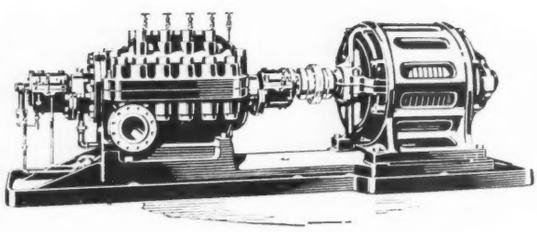

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The Relative Merits of Communism and Industrial Co-operation

TO AN EVER-INCREASING EXTENT the men and women who perform the primary basic work of American industry are acquiring a financial stake in the business that provides their employment. They are capitalists; and they spend as capitalists. Few luxury commodities are now beyond the reach of a large cross-section of the American working population. Motor cars, motor boats, radio sets, electrical conveniences of every sort, permanent waves, silken things, good food, healthful and comfortable housing—all are possible to most classes of high-paid thrifty investors among that backbone of the nation, the so-called common people.

That boring from within in a financial sense may be mutually beneficent is indicated in a recent official bulletin of the Bethlehem Steel Corporation. Within only four years, we learn, 30,000 employees have saved approximately $12,000,000 and invested it in the corporation's 7 per cent preferred stock. Under the Bethlehem plan, those purchasing stock may pay for it in installments at the rate of $4 per month per share. Meanwhile, dividends are credited to the employees; and, as an incentive to retain their shares, special dividends totaling $15 are paid or credited at the rate of $1 for the first year, $2 for the second year, and so on up to $5 for the fifth year, for every share of stock they hold. With the savings of the workers of the United States put to useful purposes in this manner, for the benefit of those who created them, through the avenues of expanding production and purchasing power, the entire industrial structure becomes so co-ordinated and interwoven as to be able successfully to withstand those periodic depressions that have characterized less prosperous times.

The world-stage is set for two gigantic social and industrial experiments, a contest for supremacy of diametrically opposed systems of individual and national life. The issue is between American capitalism, which saturates almost the entire industrial productive fabric of the United States, on the one hand, and the communism of Soviet Russia, on the other, which inhibits property rights and private ownership, and which has set up the doctrine—at home absolutely, and abroad as propaganda—that the Russian conceptions of the social and economic order are right, and that those held by the rest of the world are wrong. This generation will have passed—and many succeeding generations, no doubt—before humanity finds a solution to those social, political, and industrial problems that now engage the thoughts of statesmen, the captains of industry, and the man in the street. For reasons too obvious to require elaboration, however, the great majority of the people in the United States will probably continue to approve of an industrial policy that assures a maximum of wealth, and all that this implies, for everybody, rather than seek to apply the Russian practice of leveling all phases of human living and activity to a plane of bare existence, for the reason that little or nothing of what makes life worth while is to be had at any price—because almost non-existent.

The experience of the people of the United States in working out their destiny points unerringly to the conclusion that in neither capitalism nor communism as now conceived is the ultimate of good to be attained. Admitting with humility that perfection in any sphere of human activity or thought is not within sight, the conclusion is inescapable, however, that the greatest measure of national prosperity has been reached in countries that refuse to subscribe to the communistic theory of government.

Minerals Separation Has a Touch of Adversity

PERHAPS the most significant point of the recent decision of Federal Judge Bourquin in the xanthate suit of Metals Recovery Company *vs.* Anaconda Copper Mining Company is that made in two short paragraphs at the end. They read:

"Furthermore, the effectiveness of xanthate when used in flotation with a frothing agent had been discovered and made known in January-August, 1915, long prior to Perkins, by Martin.

"His experiments and tests were equal to Perkins' prior to application for the patent in suit, and all agree such tests suffice for transfer to mill operations. Of this, the evidence without conflict leaves no reasonable doubt."

We question if any one—even Mr. J. M. Callow, himself—ever expected that Metals Recovery could win on the basis of the Perkins patent, which, in effect, tried to blanket about 300,000 organic compounds, in a "wide domain into which Perkins had ventured little"—to use the phrase of the Court. The two paragraphs quoted are of great importance, however, because of their bearing on the claims of Minerals Separation regarding the Keller patent, which involves specifically the use of xanthate. A peculiar situation, extremely discomfiting to Minerals Separation—and, consequently, enjoyable to a large majority in the mining industry—arose soon after the Metals Recovery litigation was started.

At the outset, Minerals Separation planned to cooperate with Anaconda in the defense of the suit. The contention that the Perkins patent was too broad on general principles, and the further contention that, even if the patent were valid, xanthate did not come within its scope, suited Minerals Separation perfectly. Winning the case, so it seemed, would clean the slate, and leave the Keller patent firmly established.

But Anaconda had a further defense. In 1915, Martin, working in the testing laboratories of Utah Copper at Garfield, had used xanthate with success. He had written reports on these tests, and several copies were on file in the Utah Copper offices, where many engineers had access to them. Accordingly, the facts were matters of general knowledge. Anaconda proposed to present this evidence as additional defense in the Metals Recovery case. Minerals Separation protested, but Anaconda persisted; whereupon Minerals Separation withdrew from the case, hoping that the court would not recognize the validity of the Martin defense. In view of the decision, however, the Martin evidence apparently can be urged successfully as a defense against any suit brought by Minerals Separation and based on alleged infringement on the Keller patent. Of course, Judge Bourquin has not the final word on this point; but it is seldom that the appellate courts depart from findings of fact in the lower courts, except where error is clearly apparent. In this case the record seems definite and clear in sustaining Judge Bourquin.

Evidently, the decision frees the mining industry from the possibility that Minerals Separation might try to impose some kind of a tax based on the xanthate patent. It must be a strange experience for this company to read unpleasant documents from the courts; but a little adversity should be good for its soul.

Wood Preservatives—Their Value and Application in Mining

HOW EXTENSIVE is the use of wood preservatives in the mining industry? Some of the larger companies have experimented with them and a few are regularly treating a part, at least, of the timber they use. Figures showing the total quantity would be interesting, but apparently are not available. An extension of the practice would mean a saving in many cases. Of course, not all timber requires treatment, but, generally speaking, only that which is to remain permanently or semi-permanently in one position. Such treatment will not be profitable in those instances where ground is so heavy that timber will crush before it can decay.

These points and others are discussed in detail in the report of an investigation into methods and costs of treating mine timber just published under the joint auspices of the Carnegie Institute of Technology and the U. S. Bureau of Mines. The investigators have considered the questions of what timber should be treated and what life may be expected of treated timber. Such treatment pays under some conditions. The problem is to determine the conditions. Mine timber, if treated by some thorough preservative process, will last two to four times longer than if left untreated, the investigators conclude. In all cases where a comparison was possible, they found that the use of treated material was apparently an economy. At one mine an annual saving of $3.68 for each set of gangway timbers was shown; likewise a saving of $2.75 per set of drift timber and 25 cents per tie at other mines.

The primary aim of this investigation was to determine, as far as possible, the relative economic efficiency of treated mine timber in coal mines as compared with untreated timber. At first it was thought that the field study would be limited to the coal industry, but owing to the limited amount of authentic data obtainable, it was decided to include certain metal mines.

Ventilation has its effect upon timber decay. The conclusion should not hastily be arrived at that money may be saved by stopping the fans when mining operations are to be suspended for a year or more, the report declares. The cost of replacing decayed timber, of clearing up roof falls resulting from failure of timber weakened by decay, and of the possible loss of coal or ore in pillars should be balanced against the saving to be made by cutting off the cost of running the fans.

Treated timber must not be cut or the preservative seal broken in any manner. All cutting and framing must be done prior to the treatment. Lack of care in this respect is probably the reason for many alleged failures of treated timber, the investigators believe. Exposure of the wood below the treated surface will render useless all attempt at preservation unless complete impregnation with the preservative has been accomplished. Thorough hot- and cold-bath and pressure treatments are more efficient than dipping and brush treatments, though the latter are beneficial, according to the findings. Thorough treatment will show greater economy where long life is desired and the conditions are severe.

The quantity of wood treated by preservatives has increased steadily each year in the United States since the practice was established on a commercial basis. In 1926 the total was 289,322,080 cu.ft. This consisted of ties, poles, construction timbers, piling, and a small quantity of blocks, cross-arms, and miscellaneous material. In view of the increasing scarcity of timber and the prospect of rising prices, it is logical to assume that the next decade will see an important increase in the amount of wood treated for mining service.

Science—A Calamity or a Blessing?

AN ENGLISH BISHOP deplores as a calamity the advance of science. Privacy is only possible in the bathroom, he avers; and there is no guarantee that a picture showing him at his morning ablutions will not be thrown on the screen of a New York theater by means of television, or some other unwanted invention!

The days are past, however, when fear or timidity will stay the march of progress, although it may be a factor in delaying research. As for fear of the truth—that should belong to the dark ages. For, after all, science is merely the truth, or truth that has been organized and put to useful service. As a master, in war, science may be used for base ends; but its value in peace time is incalculable. It offers more to stimulate hope in future world conditions than any other avenue of progress.

We were privileged recently to witness a demonstration at Schenectady of the new vacuum tube developed by the research staff of the General Electric Company. As a self-excited oscillator on a wavelength of six meters it is capable of radiating fifty times more than any short-wave tube heretofore built. What use is it, the sceptics will ask? But no one can begin to compute what it may accomplish in a field to which no thought was apparently given when it was being designed.

The tube is connected with an aërial circuit consisting of a 3-meter copper bar. Those standing near experience a distinct sensation of warmth, demonstrated by clinical thermometer as an actual rise in blood temperature to fever heat. No one would dare to predict a limit to the possible benefits to humanity that may accrue from the application of these rays to diseased tissue or in the treatment of minor ailments.

Thanks to the adventurers in science, the world is seeking and finding and sometimes stumbling on facts and phenomena that must have a profound effect on human life and happiness. To the majority, science offers more of intense interest than the prospect of witnessing the ablutions of a bishop by means of the application of television.

Sources of High-Grade Refractory Material

A CURIOUS chain of circumstances led to a realization that India possesses what is probably the most important deposit of sillimanite in the world. It appears that, during the war, the Khasia Mines Company commenced the mining and exporting of what was thought to be corundum. Subsequently, in 1921, dissatisfaction was expressed by the buyers in London, and an analysis was made, which disclosed the fact that the substance was not corundum but sillimanite.

Andalusite, sillimanite, and cyanite, each an aluminosilicate mineral, possess identic chemical composition, but differ in physical characteristics. Recent research indicates that the heating of either to an adequate temperature results in the formation of mullite and glass, the latter acting as a scavenger for impurities and as a binder for the mullite crystals. A modification in nomenclature has been necessary since recognition of the fact that mullite is not sillimanite and cannot correctly be termed artificial or synthetic sillimanite, as was done before the researches of Bowen and Greig. On the other hand, perhaps, it is not strictly correct to refer to mullite when a mixture of that substance and glass is meant. Natural mullite occurs on the island of Mull, but no large reserves are known to exist there or elsewhere.

With a knowledge of the highly refractory character of the fused mullite-glass mixture, the tendency is in evidence to designate as mullite all refractory products containing mullite, which is the inevitable result of heating andalusite, cyanite or sillimanite, and also a wide variety of clay-silica mixtures. The most recent development is the melting of such ingredients and the pouring of the mass into molds. The raw material, according to Prof. W. A. Koehler, who writes on the subject in *Chem. & Met.*, is said to be diaspore or bauxite, mixed with fireclay or kaolin. The product consists of crystals of mullite and corundum, surrounded by glass.

Whatever the method of preparation, however, it is evident that mined raw materials are needed; and it is important to remember that physical characteristics, as well as chemical composition, should be taken into account in the evaluation of any new deposit discovered. The Indian sillimanite and cyanite appear to possess properties that meet with favor among manufacturers of high-grade refractories, and uniformity of composition is doubtless an influencing factor in creating this preference for specific applications.

Another Pacific-Atlantic Canal?

ONE SUBJECT has an irresistible attraction for the politician: the possibility of recommending a vast expenditure for some new project. Yet the construction of another waterway to link the Atlantic and Pacific oceans is a problem that deserves to be tackled from the engineering standpoint. However, the subject is one that has already assumed a political angle, with rich gestures from Washington that a quarter or a half billion dollars be spent in Nicaragua for this purpose. A Congressman has only to plan a trip through the Canal to feel himself qualified to urge a second waterway as a national necessity deserving of immediate consideration. An engineer in a position to judge will doubtless agree that the present traffic through the Panama Canal can be doubled and then almost doubled again before capacity is reached; especially if additional provision is made for increasing existing facilities in the Zone area.

The tendency is to build larger ships, and this will be reflected in an economy of water and time in the operation of the locks. A diminution in the production and transport of oil from California appears inevitable; this also will automatically reduce Canal traffic. The West Coast of the United States is becoming increasingly self-dependent, and is looking to the East and the South for foreign markets. Only a fast and regular freight and passenger service between California and Chile is needed to deflect much traffic from the East Coast. When the present Canal is used to a least half maximum capacity, it will be time to investigate the necessity or the opportunities for another engineering achievement of a magnitude similar to what has been done on the Isthmus; but the less politics in the venture the better.

Loyalty and Long Service

FROM the current annual report of the Calumet & Hecla Consolidated Mining Company the following is extracted: "It is with sincere regret that we announce the resignation, on Oct. 1, of Mr. Thomas H. Soddy, Superintendent of Motive Power, the company's oldest employee in point of service. Mr. Soddy has been employed in the motive power department for 61 years and for the last 18 years has been at the head of the department. His administration of the work under his charge has been most efficient and his loyalty to the company's interests unfailing."

When Mr. Soddy put in his first shift for Calumet & Hecla in 1867, neither Marcus Daly nor W. A. Clark had opened the rich copper veins that were to bring them fortunes at Butte; no one suspected that Arizona harbored copper in such quantity as to make it the leading copper producing state in the Union within fifty years; and not until two years later did Mr. D. C. Jackling first see the light of day. Yes, 61 years is a long time.

Without any further facts at hand than those printed, one's imagination, if allowed free play, might go astray in thinking over the sentimental aspects of this long and —surely—happy connection. It is not too much to say, however, that it reflects a policy of promotion within the ranks; and loyalty on the part of both the worker and the company. The formal mention of Mr. Soddy's retirement in the annual report is a graceful compliment. We hope he will live many years to enjoy the fruits of a long career of service and usefulness.

More Copper From Union Minière

Big Congo Producer Makes Progress Toward Goal of 140,000 Tons in 1930

By Owen Letcher
Johannesburg, South Africa

Principal street in Elisabethville, center of Union Minière activities

UP TO THE PRESENT there has been a disposition in generally well-informed quarters to underrate the possibility that Union Minière du Haut-Katanga may attain a position of dominating ascendancy in the copper industry. The skepticism dates from the earliest authenticated reports as to the magnitude and richness of the deposits. Scarcely anybody believed the assertions of George Grey, Baines, Alan Gibb, and the other prospectors and engineers of the earliest days. Later in 1908 came the depressing report of Frecheville, the English mining expert, who considered that remoteness and metallurgical difficulties would preclude the copper fields of the Congo from entering upon any career of real prosperity. Three and a half years ago, when I was in New York, I again encountered a feeling of skepticism with regard to Congo copper. There was a feeling of doubt or else a not unnatural tendency to refuse to admit facts and figures as to the only mining enterprise which is likely to rival American mines for supremacy as the world's leading copper producer. In the last three years Union Minière's output has not expanded to the degree that one expected. The peak production of more than 90,000 tons in 1925 has not so far been exceeded. The reason for this lack of expansion has been that the company has for two years been engaged on the completion of the first unit of a huge program of construction, and there has been an insufficiency of labor to maintain production, much less to expand it, and at the same time to push ahead with the program of construction. The initial portion of this program, which is designed eventually to secure for the Union Minière a position of predominating importance in the world's copper affairs, is now, however, approaching completion. Part of the plant is already productive. Other units are approaching completion. Railways are hastening from the West Coast to the great mineral belt, and the time now appears to be opportune for the presentation of an article which will set forth the essential facts and figures of Union Minière at the present day, which will summarize the history of this remarkable undertaking to date, and at the same time show what may be expected of the company in the future.

The Katanga "Copper Rand" may be said to extend over an area about 200 miles long from northwest to southeast and, say, 70 miles wide at its broadest point. Lufira River cuts through this belt at approximately its narrowest width, where it thins down to about 20 miles. The most southerly property which is now being worked is near Elisabethville, and is known as the Ruashi mine. This property has been opened up during the last three years and is now contributing a large tonnage of high-grade ore to the smelters.

The copper belt extends northward to Chilongo, eastward in the direction of Lake Mweru, and westward to Mussonoi, and probably beyond Mussonoi toward the Angolan border.

Associated with the cupriferous areas are less important, although noteworthy, deposits of tin and gold, uraninite and other radio-active minerals, cobalt, and coal. These deposits constitute one of the most extensive and valuable mineral belts as yet discovered anywhere in the world, and they are all under the control of one great Belgian company, Union Minière du Haut-Katanga, with which are associated the British enterprises presided over by Sir Reginald Wingate and Robert Williams, and known as the Tanganyika Concessions and the Zambesi Exploring Company. Several eminent American mining and metallurgical engineers have played an important part in the exploitation of this remote and spectacular enterprise.

In 1906 the Belgian company, the Union Minière, took over, under arrangement with the Comité Special, the Katanga mineral concession, with all the discoveries which the Tanganyika Concessions company had made, the remuneration to Robert Williams' companies being a 40 per cent interest.

The organization of Union Minière du Haut-Katanga is divided into four principal departments. These are:

1. The department of "main d'oeuvre indigene," or native labor, which organizes and administers recruiting, transport, housing, medical service, and the policing of native labor. It is estimated that a minimum of 18,000 natives are required to maintain the complement of the company at full strength.

2. The department of mines, with headquarters at Panda which controls the working of all mines of the U.K.M. Its special function is to insure a regular supply of ore in accordance with a fixed program to the third department.

3. The department of plants, which supervises the metallurgical operations of the company and controls processes of ore treatment. This department is responsible for the delivery of the prescribed quantity of metal according to the program of production.

4. The department of "etudes et constructions" (studies, construction, and buildings). This department works ahead of, and in conjunction with, the other departments, without having any direct administrative contact with them. Its dominant object is to accomplish the complete laying out of the series of plants until a production of 200,000 tons per year has been reached.

Each of the above departments is subdivided into a number of sections according to the locality where operations are conducted.

Ruashi open-pit mine, one of the six important deposits now being exploited

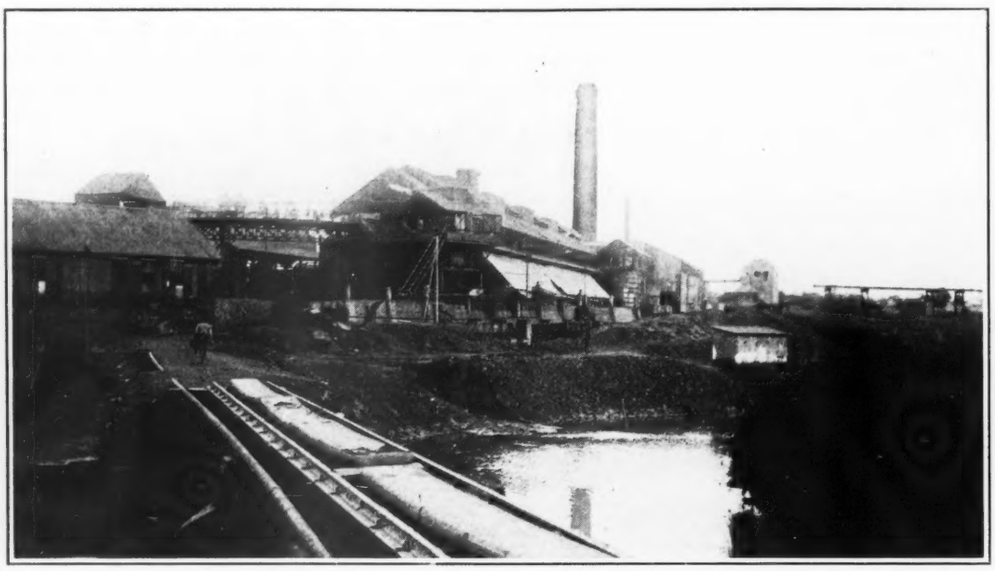
It will be appreciated that a vital consideration in securing the effective working of this organization lies in securing the efficient and synchronous working of departments Nos. 2 and 3, but in point of fact department No. 2 has often been unable to deliver to the reduction plants the required quantity of ore. The reason for this inadequacy of ore supply invariably has been lack of the necessary supply of native labor to operate the mines at full capacity. There have indeed been occasions when this shortage of supply has been so acute (largely because fewer Rhodesian boys go to work in Katanga today than formerly, since they now find work in Rhodesia through the activities of the Bwana M'Kubwa and other companies) that the general manager of the U.M.K. in Africa recently ordered the diver-

sion from department No. 4 of a very important complement of natives to be placed at the disposal of department No. 2. This transfer explains why department No. 4 has found it impossible to execute with the desired rapidity the completion of the new leaching plant.

It may now be useful to enquire into what has actually been achieved during the last year or two.

Next come the activities of department No. 2. Of the 180-odd mines already located, only five or six are now being exploited: the Kambove, Ruashi, Luishi, Kipushi, and one or two other less well-known properties where exploration is yet the most important activity.

Owing to labor shortage, the department of mines has been compelled to adopt mechanical means in substitution for man power wherever possible. This process of



Reduction works at Lubumbashi, where copper ore is smelted

Department No. 1 recently organized a big recruiting campaign in the Lomami province and in the mandated territory of Ruanda-Urundi. Also, it has supervised the building of rest houses along the routes traveled by the natives on land. It has also purchased boats for the Congo River, and from Bukama all natives are now transported by train. These natives are well fed on the way, and their engagements are entered into quite voluntarily without any pressure. White recruiters are employed, and each comes back from the interior with, on an average, 120 to 130 natives. The total charges bring the cost of a native on arrival at the scene of his labors, on an average, to about £5. Notwithstanding all the company's strenuous efforts to bring the total complement up to full strength, the supply of natives is still insufficient, though the total number employed at present amounts to between 13,000 and 14,000. To sum up the situation, department No. 1 has so far been unable to supply the necessary natives to department No. 2. This shortage of native labor has, of course, proved a great handicap, and it is a disability that cannot be corrected in a short time, though late advices are that progress is being made.

Conditions in respect to housing and feeding the natives are consistently being improved, supplies of mealies are liberal, and the quantity of meat issued is being increased. The management of Union Minière looks far ahead. In addition to a genuine desire to give a "square deal" to the natives, the company is endeavoring to promote the health of the "indigenes," so that the native population will increase. Bonuses are paid to the parents of native children born in Katanga, and in every way the management is trying to solve the problem of native labor supplies in the years to come.

industrial evolution is being intensified; but it must be still further developed on a big scale if the continuity of Union Minière's program is to be maintained. Up to date the consideration which has retarded the carrying out of a program of wholesale displacement of colored labor by machinery has been the initial cost. It has always been assumed that natives are cheaper than machines. For a long time the management of Union Minière was able to choose between natives and machines. But today the development of this great mineral belt is going ahead so rapidly that the choice is no more between natives and machines but between machines and admission of inability to consummate the program. Thus, under the pressure of necessity, the employment of mechanical devices is being extended and will continue to be further developed.

In the opinion of numerous competent investigators the low efficiency of native laborers in the Congo renders colored man power at least as dear as mechanical equipment when all overhead charges in respect of recruiting, housing, feeding, and medical attendance are taken into account. It is for these reasons, then, that Union Minière has for some years been purchasing labor-saving machines of all kinds. Steam and electric shovels and rock drills of various types are in operation, and even more ambitious programs than have hitherto been contemplated for the further intensification of the mechanical program are now necessary.

Next comes department No. 3, that dealing with plants, metallurgy, and production of metal. In regard to these it is necessary first of all to differentiate between the locations of the various plants: (a) at Lubumbashi; (b) at Panda, (c) in Belgium.

At Lubumbashi there are eight water-jacketed fur-

naces, of which a number are frequently out of commission on account of cleaning and repairs, or because of shortage of delivered ore. At least four of the furnaces are, however, constantly burning, and each gives in round figures 20,000 metric tons of metal per year, or 80,000 metric tons in the total. Besides the water-jacketed furnace there is one reverberatory furnace. At Panda ores are concentrated in a plant having a capacity of 4,000 metric tons per day; the coarse concentrates are sent to the Lubumbashi furnaces, and the fines are treated at the new reverberatory plant at Panda. Four such furnaces are either completed or under construction. Of these, two were fired in 1927, and the third started operating early in 1928. Construction of the fourth furnace is in hand, and this should come into operation in the middle of 1928. The minimum productive capacity of each furnace is 9,000 tons of metal per annum, so that the total output of the four reverberatories when working at capacity will be not less than 36,000 metric tons of copper per year.

It is some years now since Union Minière began experiments with leaching in application to Katanga ores. A pilot plant was installed six or seven years ago and still remains at Panda Hill, but this probably will be dismantled as soon as the first unit of the large and permanent leaching plant comes into operation. This is now being constructed.

Mention should also be made of the fact that at Panda are the electrical furnaces for treatment of the rich cobaltiferous ores frequently found in association with copper ores in the Katanga.

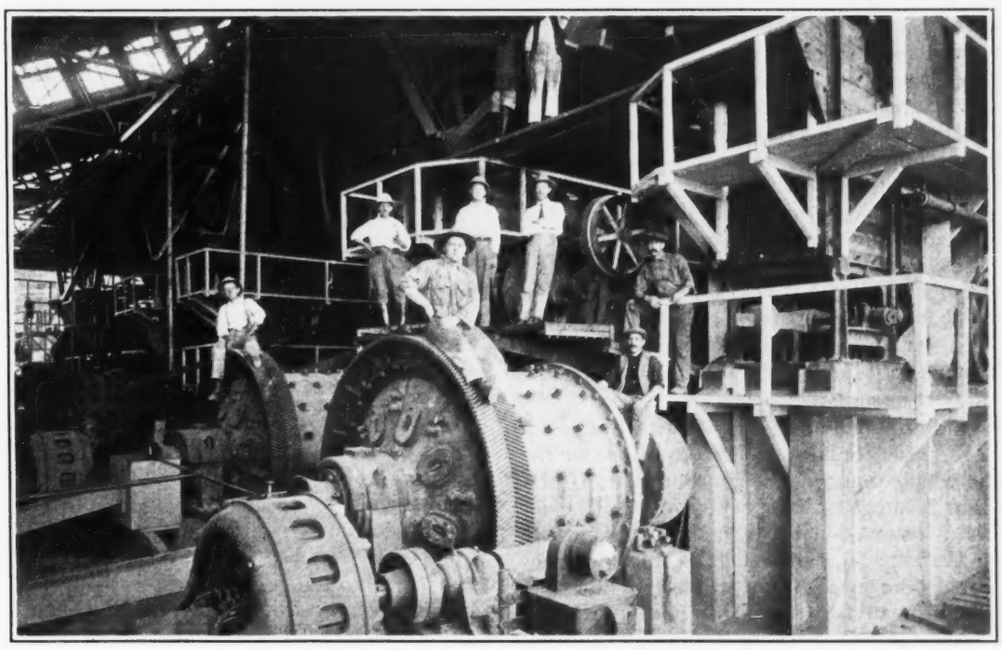
In Belgium are two metallurgical departments, one at Antwerp-Hoboken and the other at Oolen (40 km. from Antwerp). At the Antwerp works concentrates of tin treats the uranium ores from the Chinkolobwe mine, near Panda.

The copper refinery at Oolen sells its finished product to Continental buyers. American buyers are supplied by the Nichols Copper Company's refinery in the United States, to which part of the Katanga output of rough copper is consigned. It is understood that the question of building a refinery in England has also been considered, but no decision has as yet been come to in this respect.

The principal work upon which the department of studies and construction is engaged at present is the completion of the first unit of the big leaching plant at Chituru, near Panda. This plant is situated close to the main road from Elisabethville and in line with the Likasi mine, and has been designed for a production of 36,000 tons per annum. Later two other units, each of the same capacity, will be erected. It will probably take another year or a year and a half to complete the erection of the first unit.

Following is a brief summary of the present position in regard to production and the program in this regard for the next year or two:

Period	Annual Capacity Copper, Metric Tons
Actually producing end of 1927	
Lubumbashi, Four water-jacketed furnaces	80,000
One reverberatory furnace	10,000
Panda Two reverberatory furnaces	.....
One small pilot leaching plant	18,000
	108,000
Addition in 1928	
Panda—two additional reverberatory furnaces	18,000
	126,000
Addition in 1929	
First unit leaching plant of 36,000 tons per annum—at capacity only half year during 1929	18,000
Total	144,000



Panda concentrator, one of the newer plants

produced by the U.M.K.'s mine at Busanga are treated and also mixed ores, containing cobalt and silver. At Oolen the first section of a copper refinery capable of dealing with 30,000 tons of rough copper yearly has been erected. Here also is situated the radium plant which

That, in effect then, is the program of the U.M.K. in respect of production for the early future. The 1927 output was in the neighborhood of 85,000 tons, compared with 81,000 in 1926 and 90,000 tons in 1925. The decline in recent production has been due mainly to

diversion of labor to constructional work; but it seems reasonable from the foregoing to predict that from now onward output will expand, and that at the same time profits should increase substantially. In addition to securing increased output, there may be a lowering of the cost of producing and marketing a unit of metal. Costs of production will be reduced mainly through: (a) The completion of the Lobito Bay Railway and to a lesser degree by completion of the B.C.K. railway. (b) The substitution of electricity for coal as a source of power. (c) Reduction in overhead charges per unit of output on account of increasing the rate of production. (d) The operation of its own refinery, thereby producing electrolytic copper ready for the market.

The Lobito Bay Railway has now reached the Portuguese Congo border, and in another two years will be completed to Chilongo or Panda. The production of electricity in the U.M.K.'s concession is still in its infancy. A large subsidiary company with a capital of 150,000,000 fr. has been launched. The technical direction of this enterprise will be entrusted to the "Sofina," which is a big international company operating hydro-electric properties in Canada, the Argentine, Mexico, and elsewhere. The executives of this concern are thoroughly experienced in the operation of hydro-electric plants. Five years or more will probably elapse before the first phase of the application of electric power to Union Minière on a large scale is completed.

Production of electrolytic copper will, as already stated, be 18,000 tons in 1929 and 36,000 in 1930. Electricity for this production will be generated by the steam-power plant at Panda.

Looking forward into the future, output is likely to expand to 200,000 tons or more per annum as the second and third units of the leaching plant come into operation. By 1930 the company's profits should be substantially enlarged on account of: (a) the use of the West Coast harbor, which will result in a saving of at least £4 per ton in railage; and (b) income from selling 36,000 tons of electrolytic copper produced in its own plants.

It will be gathered, then, from the foregoing that Union Minière is now entering upon a fresh and very important phase of its productive and profit-earning activities—an epoch during which both the revenue and dividends of the company may be expected to expand.

In regard to railway projects, the Lobito Bay line has crossed the Angola-Congo border and should reach the copper belt in about two years. Meanwhile motor-car service has been established between Katanga and the railhead, so that passage to Europe via Lobito can now be secured without difficulty.

The Compagnie du Chemin de Fer du Bas Congo au Katanga (B.C.K.) was founded in 1906 by the same interests as those which founded, in the same year, Union Minière du Haut-Katanga. The purpose of the B.C.K. was to establish a connection between the Congo River mouth and the Katanga, but inasmuch as this construction clearly would take many years, Robert Williams—the leader of the Tanganyika Concession group—formed the Rhodesia-Congo Border Junction Railway Company, which in a short time built the railway from Broken Hill to Sokania. Simultaneously the Belgian group created a subsidiary company, Chemins de Fer du Katanga, which built the railway from Sakania to Elisabethville. The essential object of that railway—Broken Hill to the Star mine and Elisabethville—was to bring Union Minière to the productive stage as rapidly as possible, but this was never regarded as other then a temporary measure and the necessity for having an outlet or outlets to the Atlantic seaboard was ever kept in mind.

During the war years the building of the first section of the B.C.K. railway—Elisabethville to Bukama—was achieved. When post-war finances had been put in order in Belgium as well as in the Congo, the B.C.K. company decided to continue the program, and the line was carried from Bukama to the Kasai River (Ilebo or Port Francqui). Construction was started from both Bukama and Ilebo and the two constructional parties should meet in April of 1928. A third section will be built from the Kasai River to Leopoldville to join the railway Leopoldville-Matadi harbor on the west coast. It is understood that negotiations are now in progress in Brussels in regard to an increase of capital to build the third section—Kasai River-Leopoldville.

Selenium in Copper Bullion

THE determination of selenium in a copper bullion by the usual methods is rather long and unsatisfactory. H. W. Jones, writing in *The Chemist-Analyst*, says that he has simplified and shortened this method considerably as to manipulation and time and with no injury to the accuracy of the determination. His description follows:

Sample used, 10 grams. Add 20 c.c. of 1-1 HNO_3 and evaporate to dryness on a steam bath or part of hot plate where it will never actually boil. When dry continue heating until all HNO_3 is driven off. Add 50 c.c. of 1-1 HCl and heat without boiling until all copper salts are in solution. Filter off all AgCl and wash well, keeping account of amount of water used for calculating purposes in diluting the filtrate so it shall contain 70 per cent HCl. The solution at this point should be about 800 c.c. in volume. Cool. Pass in SO_2 at the rate of 2 or 3 bubbles a second for five minutes. Let stand 15 minutes and filter on a weighed gooch. Dry at 100 deg. C. and weigh as metallic selenium. Do not dry at over 100 deg. C., as selenium is volatile.

Note: At the point where the AgCl is filtered off the solution may come through cloudy because of lead, but on making up to 70 per cent HCl strength all Pb is held in solution. Wash the crucible with the Se with warm water to insure no $PbCl_2$ coming down.

A New "Dry Blower" for Recovering Alluvial Tin

IN ADELAIDE, South Australia, a demonstration was recently given of a new "dry blower" for recovering tin oxide. This separator is the invention of F. C. Perkins and J. Wesley. Its mechanism is simple, the power required is small, and the dust raised by it when in use is delivered at such a distance as to cause no inconvenience to the workers.

The separator was designed to win the tin oxide occurring in alluvial deposits found in certain dry areas of Australia. In these deposits the tin is found in lumps of argillaceous and arsenaceous material, mixed with larger pieces of quartz. This material is easily pulverized and the ore freed from gangue, the lumps of quartz being screened out. The apparatus used consists of a portable dredge, with duplex hoppers and screens and having a single elevator, with the Perkins-Wesley separator and blower.

Caving With Branch Raises

By Charles A. Mitke

Consulting Mining Engineer, Phoenix, Ariz.

IN THE DEVELOPMENT of the general plan of operations, main hoisting shafts are located far enough from the orebody so as not to be affected by surface subsidence[1]. From these, long drifts are driven to the orebody, being generally from 30 ft. to 200 ft. beneath the bottom of the ore. The size of the area to be undercut at any one time varies, depending on the firmness and standing qualities of the ore. In a new orebody, some regular sized block is chosen—as, for example, 200x200 ft. Miami at present uses 150x300 ft., and with an average height of ore (250 ft.), this block contains about 1,000,000 tons. In old mines, the area of the block not only depends on the character of the ore but on the irregularities of the remaining unmined portion, as the newer stopes must frequently be fitted in between older ones.

In high-grade orebodies, in order to transport the ore from the stopes to the haulage level, considerable hand shoveling and hand trimming, or scraper work, with transfers, is frequently necessary. The lower-grade ores will not permit such expensive handling, and, therefore, a plan of development work, consisting of long incline raises, with shorter raises branching from them, has been worked out to permit the broken ore to run by gravity, and thus eliminate the hand work mentioned above. (See Fig. 1.)

In mining an orebody by the branch-raise method, the main point of attack, or undercutting level, is immediately under the block to be caved. Between the point of attack and the main haulage level is an interval, which may range from 30 ft. up to 200 ft., but, in general, is about 75 ft. Between these two levels is a third level, known as the grizzly, or breaking level. In the branch-raise system the ore is conducted from the point of attack, or undercutting level, to the grizzly level through a network of small inclined chutes, known as "finger raises." In the low-grade orebodies mined by the branch-raise system, only approximately 10 per cent of the ore is broken by drilling and blasting on the undercutting level, in the primary mining operation; the remaining 90 per cent is crushed and broken in the natural process of caving. The ore comes down through the finger raises as fines and irregular-shaped boulders; and, to reduce these to a size convenient for handling through chutes and raises, a secondary blasting operation is conducted on the grizzly, or breaking, level. At intervals, in the floor of this level, gratings made of rail (spaced from 9 to 14 in. apart) are laid, beneath which are large inclined raises, connecting with the main haulage level below. These large incline raises between the grizzly and haulage levels are really storage pockets, which hold a sufficient reserve of broken ore to cover delays and permit continuous operation. Almost all main-storage raises connecting with haulage levels are driven on an incline of about 55 deg., and are approximately 25 ft. apart. Finger raises are inclined from 33 to 45 deg.

The main haulage drifts are parallel, and generally spaced from 100 to 150 ft. apart. The number of drifts on the main haulage level depends on the lateral extent of the ore, and the vertical interval between the haulage level and the grizzly level above. The greater the vertical interval, the wider the haulage drifts may be spaced apart. This, however, entails a proportional increase in the amount of raising.

Parallel Drifts on Grizzly Level

The grizzly level consists of a series of parallel drifts, from 25 to 75 ft. apart, depending on the character of ground being drawn. Some companies drive the grizzly drifts at right angles to, whereas others drive them parallel with, the main haulage drifts. The grizzly is the collecting level for all the draw points, or finger raises, above. Although a more even draw is obtained by having the drifts on the grizzly level located close together, there is an economic limit, both from the standpoint of the extent of the original development work, and the standing qualities of the ground. The development work on the grizzly level is solely for the purpose of extracting the ore immediately above. Once the ore is caved and drawn, the grizzly level is of no further use and is allowed to cave. Frequently, the life of a grizzly level is no longer than four to six months, when it is abandoned and a new section prepared for mining. Therefore, the expenditure involved should merely be sufficient to maintain it in a safe workable condition until it has served its purpose. For this reason, grizzly drifts are usually driven small (3½x6 ft.) and timbered only when necessary. Where the character of the ground permits, a spacing of 25 ft. is advantageous, but this same spacing in other types of caving ground would entail a prohibitive upkeep cost. In the Globe-Miami district, a spacing of 50 ft. has been found economical;

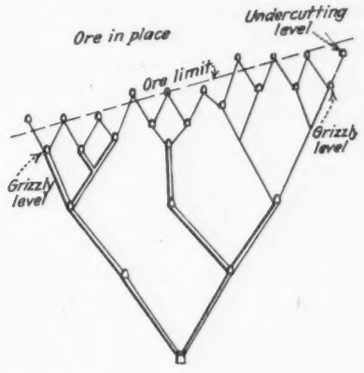


Fig. 1—Tree effect—branch-raise system

[1]This is the eighth of the series by Mr. Mitke in which he outlines modern stoping methods.

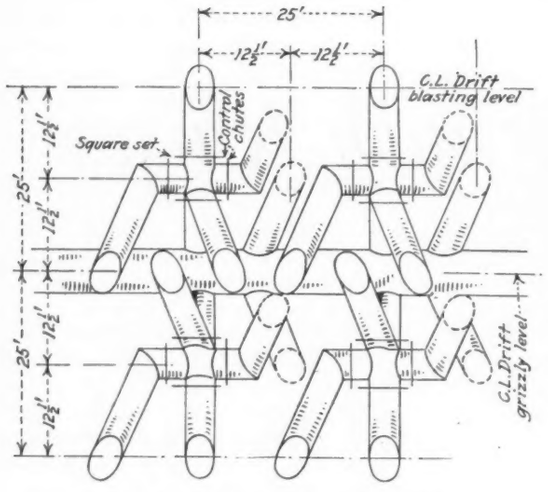


Fig. 2—Finger raises, plan view

at Ray, a 25-ft. spacing in the harder ground is permissible; in Morenci, a 28-ft. spacing has been found satisfactory. On the other hand, there are camps in which the grizzly levels are spaced as far apart as 75 ft.

Haulage and Grizzly Levels in Country Rock

The haulage and grizzly levels are generally driven in the country rock beneath the orebody. The drifts on the undercutting level are driven in the ore, usually at the bottom. Frequently, however, the bottom of an orebody is irregular and does not lie on the horizontal; consequently, an effort is made to have the undercutting level follow the ore as closely as possible.

Narrow boundary shrinkage stopes are carried up on one end and two sides of a block to be caved. These stopes are usually 6 to 10 ft. wide; they cut off the block to be mined from the solid. This phase of the development work is always kept ahead of the drawing. The rapidity with which it is advanced depends upon the speed with which it is desired to have the block settle.

All the above development work must be done before mining operations start. The cost of this preliminary work may run from 10 to 30c. per ton, depending, to a large extent, on the height of the ore.

The same amount of development work put in for a height of ore of 75 ft. has been used to equal advantage in a block 200 to 300 ft. high (vertically). Consequently, the higher the block to be caved, the larger the tonnage served and the cheaper the proportionate cost of the development work per ton. The height of the block that it is possible to cave economically is, of course, governed by the character of the ground in which the development work must be prosecuted. If too high a block is taken, and the development raises require timbers and necessitate frequent repairs, they may wear out long before the entire amount of ore has been extracted. In such operations it may be necessary to take shorter lifts.

Branch-Raise Caving Method

The branch-raise system of caving consists in undercutting an orebody, thus allowing the ore to cave and crush; then drawing off the broken rock through several small, evenly spaced, incline finger raises, which lead to the breaking, or grizzly, level, and from there the ore runs down main incline raises to the haulage drifts and motor cars. The branch-raise method is applicable to ground that may be drawn freely, after it is once undercut. In ore that is hard, or firm and blocky, or ore which packs because it is sticky, some combination of shrinkage and caving should be used.

The branch-raise method is in use in five large camps —Inspiration, Miami, Andes Copper, Nevada Con., and Morenci (softer ores only). At each of these properties, the development work, up as far as the grizzly, or breaking, level, is almost the same; that is, the location of shafts, the driving of main haulage levels, and the putting up of large incline raises, or main arteries, for the passage of broken ore from the grizzly, or breaking level, to the ore cars beneath, is essentially the same.

From the grizzly, or breaking, level, up, however, variations are in use at some of the camps. Inspiration,

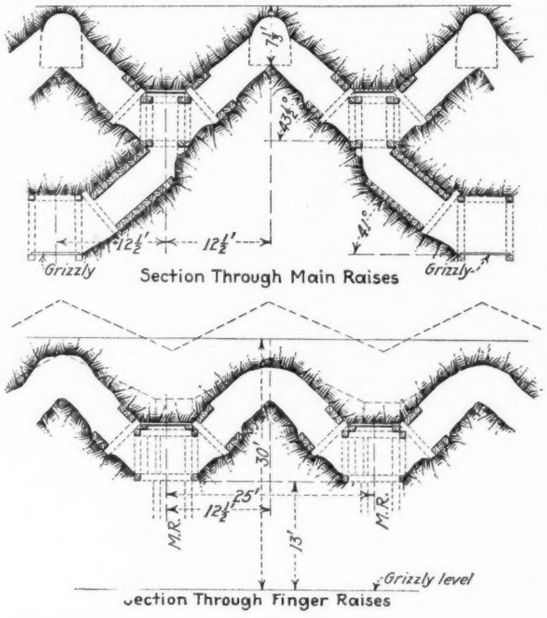


Fig. 3—Section of square set between grizzly and undercutting level (Inspiration, Miami, Andes)

Miami, and Andes Copper all drive regular grizzly drifts, 50 ft. apart. The main drawing points are from square sets, located about midway in the raises leading from the grizzly up to the undercutting level. Fig. 2 is a plan view of the finger raises from the grizzly to the undercutting level; Fig. 3 is a sectional view through the square set between the grizzly and undercutting levels. The drawing shows the character of timbering used in the average heavy ground. In principle, these three large properties use exactly the same method, and differ only in minor details. Miami, for instance, drives its haulage drifts at right angles to, whereas Inspiration drives its haulage drifts parallel with, the grizzly level. Then, again, Miami turns the square sets (located in the raises above the grizzly level) at an angle of 45 deg. with the grizzly level, whereas at Inspiration they are turned at an angle of 30 deg. In both instances, the spacing of the finger raises, where they funnel out on the undercutting level, is the same, and the incline of the raises, in each instance, is about 45 deg. However, when they are driven from the sides of square sets, set at an angle of 30 deg. with the grizzly, a slight curve is necessary in order to reach the desired point on the undercutting level; whereas, when the square set is located at an angle of 45 deg., no curve is required.

At the Nevada Consolidated Ruth mine, instead of driving regular grizzly drifts, development work is prosecuted by coming up the main raises from the haulage level below, to what will ultimately become the grizzly level. The tops of these raises are then widened out sufficiently to permit the erection of square sets containing grizzlies. From each of these square sets, two short finger raises are run up to the undercutting level, at the bottom of the ore.[2] The reason for this variation is that the ground is so heavy that repairs in maintaining regular grizzly drifts would be excessive. Under these conditions, manways are maintained in the main storage raises between the haulage level and the square sets at the top of the raises, or grizzly level, from which the finger raises branch off. These manways are the only means of access to and egress from the grizzly level and the undercutting level above. All ore is then drawn by hand in the square sets on the grizzly level, instead of from square sets located higher up, as in the operations at the other companies. (Fig. 4.)

Hardness of Ore Affects Practice

All the branch-raise variations call for the driving of a series of drifts on the undercutting level, about 10 to 30 ft. above the grizzly, or breaking, level. At Inspiration, Miami, Nevada Con. (Ruth Mine), and Andes Copper, the undercutting level is horizontal, and also in the hard ore at Morenci. However, in the softer ore (Morenci and Ray) the drifts in the undercutting level are driven at varying elevations, so that when an undercutting level is completed, instead of being horizontal, it assumes the aspect of a rill stope.[3]

At Inspiration, Miami, and the Andes Copper, incline raises are driven up from the grizzly level approximately half the distance to the undercutting level above. At this midway point, as previously mentioned, timbered square sets are erected, and, from each of these, four finger raises, containing chute gates, are continued up to the undercutting level. At the Ruth mine, Nevada Con., the square set is located on the grizzly level, and only

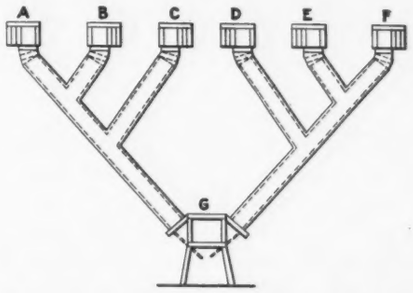


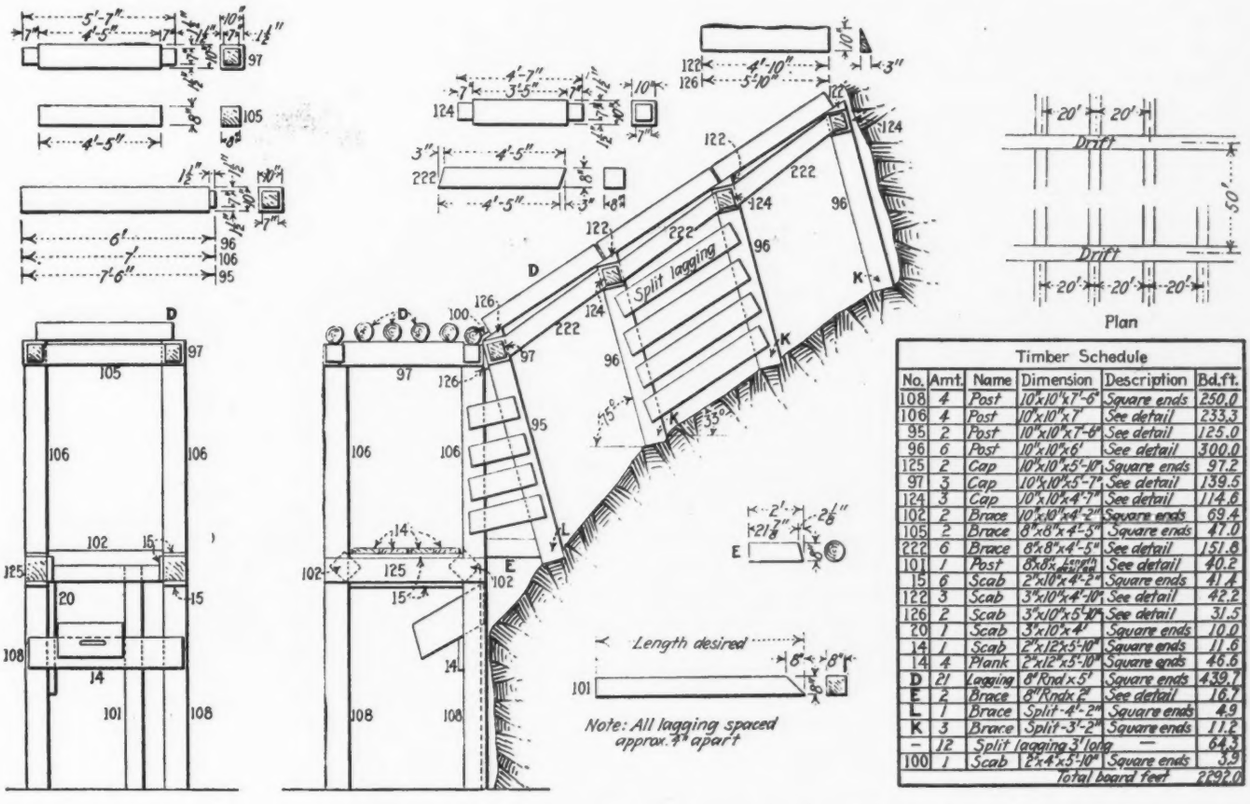
Fig. 4—Square set on grizzly at Nevada Consolidated

two finger raises lead up from the square set to the undercutting level above. In the softer ores at Morenci, drift sets are erected on the grizzly level, and incline raises driven from opposite sides, at an angle of about 33 deg. These extend from 10 to 30 ft., but may reach up to the undercutting level. These raises are timbered with from five to ten sets of heavy drift timbers, depending on their length. From each side of these timbered incline raises, small finger raises are put up, at alternate sets, to the rill-shaped undercutting level. This permits of many more drawing-off points than when a single square set, with its four finger raises, is used. (Fig. 5.)

A further variation in use at Morenci is to eliminate

[3] "Branch Raise System at the Ruth Mine." W. S. Larsh. *Trans.* A.I.M.E. Vol. 59.

[2] *E.M.J.*, Vol. 120, p. 1006.



Timber Schedule

No.	Amt.	Name	Dimension	Description	Bd.ft.
108	4	Post	10"x10"x7'-6"	Square ends	250.0
106	4	Post	10"x10"x7'	See detail	233.3
95	2	Post	10"x10"x7'-8"	See detail	125.0
96	6	Post	10"x10"x6'	See detail	300.0
125	2	Cap	10"x10"x5'-10"	Square ends	97.2
97	3	Cap	10"x10"x5'-7"	See detail	139.5
124	3	Cap	10"x10"x4'-7"	See detail	114.6
102	2	Brace	10"x10"x4'-2"	Square ends	69.4
105	2	Brace	8"x8"x4'-5"	Square ends	47.0
222	6	Brace	8"x8"x4'-5"	See detail	151.8
101	1	Post	6"x8"x Length	See detail	40.2
15	6	Scab	2"x10"x4'-2"	Square ends	41.4
122	3	Scab	3"x10"x4'-10"	See detail	42.2
126	2	Scab	3"x10"x5'-10"	See detail	31.5
20	1	Scab	3"x10"x4'	Square ends	10.0
14	1	Scab	2"x12"x5'-10"	Square ends	11.6
14	4	Plank	2"x12"x5'-10"	Square ends	46.6
D	21	Lagging	8" Rnd x 5'	Square ends	439.1
E	2	Brace	8" Rnd x 2'	See detail	16.1
L	1	Brace	Split - 4'-2"	Square ends	4.9
K	3	Brace	Split - 3'-2"	Square ends	11.2
–	12	Split lagging 3' long		—	64.3
100	1	Scab	2"x4"x5'-10"	Square ends	3.9
				Total board feet	2292.0

Fig. 5—Morenci timbered slide with incline raises

the short finger raises from the timbered incline raise and blast the ore directly over the timbers of the incline raise. (Fig. 6.) The ore is always drawn from alternate sets of the incline raise, first one set of alternates being used, and then the opposite set, thus affording twice as many drawing points as when finger raises are used. At Miami, a somewhat similar variation was in use, in the high-grade ore, several years ago; but owing to the fact that horizontal drifts were used in place of

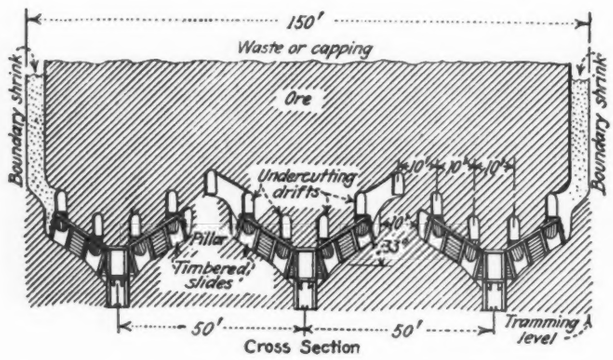


Fig. 6—Morenci timbered slide; ore blasted directly over timbers

incline raises, and the undercutting level was also on the horizontal, all ore had to be trammed; whereas, in the Morenci variation, the ore runs by gravity. This method, however, has a limited application. The ore must be soft, so as to require very little bulldozing, but must also be sufficiently firm so that the timbered incline drift will hold while a height of 50 to 100 ft. of ore is drawn through it. If a greater height is taken, the drift usually requires excessive repairs. This method has proved ideal in the softer ore at Morenci, and is responsible for about 30 per cent of the daily production of about 4,500 tons.

Methods of Drawing Ore

At Inspiration, Miami, and Andes Copper, the man in the square set, midway between the grizzly and undercutting levels, draws the ore down through the finger raises, and from there it runs by gravity to the grizzly level; at the Ruth mine, the man stands in the square set on the grizzly level; at Morenci, the man is in the timbered incline raise, or "timbered slide," as it is locally termed, and draws the ore from alternate points in both sides of this raise. At all these properties, large boulders are blasted by men on the grizzly level. With the branch-raise method anywhere from 15 to 30 tons per man, for every man in the mine, is obtained.

In most of these mines, shrinkage stoping is employed as a supplementary method for the purpose of establishing the limits of the section being mined. When a block of ore is merely undercut, the walls frequently continue to support the overburden and form a bridge which holds up the mass above. As a consequence, either irregular caving, or no caving at all, takes place. To avoid this, at least three sides, and in exceptional cases four sides of the block, must be cut off vertically from the main body of ore, so as to allow the block to settle and cave. This is effected by carrying up narrow, so-called "boundary shrinkage stopes." There are several methods of carrying up these stopes. In some camps, the regular shrinkage method is followed, the man standing on the broken ore and drilling the solid overhead. In others, a series of parallel drifts, one above the other, about 33 ft. apart, are driven, and the ore is broken from these. Still another method is to use incline raises connected with short drifts at 20 ft. lifts, and drill the top and bottom of the drifts.

Sublevel Caving With Branch Raising

The caving systems used in the iron mines of Michigan vary considerably from those in use in the large low-grade porphyry coppers. The vertical extent of the ore caved is rarely more than 16 to 30 ft. as compared to 75 to 300 ft. in the low-grade copper mines. This is largely attributable to the shape and size of the orebodies. As the vertical height caved approximates the distance commonly left between sublevels, the system is generally known as "sublevel caving."

There are many variations of sublevel caving. These will be discussed in a later article, but the method described below is that form of sublevel caving in which branch raising is used to collect the ore (Fig. 7). In this method, the general development is as follows, as detailed in "Mechanical Loading Underground," by C. E. Van Barneveld, in University of Missouri Bulletin, Vol. 7, No. 3:

"Main[4] levels are usually opened at 100-ft. vertical intervals. Parallel main level drifts are opened in the orebody at 48- to 64-ft. centers. At 16- to 24-ft. intervals, inclined raises are put up from these drifts to the top sublevel. These raises are generally inclined parallel to the footwall; sometimes it may be necessary to incline raises to the hanging wall. Sublevel intervals are 18 to 20 ft. Branch raises are put up from the main raise at each sublevel to the sublevel above, inclined in one to three directions. The top sublevel is opened by drifting and crosscutting over the raises, the ore broken in this work being blasted directly into the raise. A small

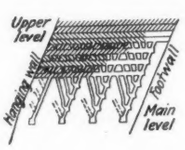


Fig. 7—Sublevel caving into branch raises

proportion may have to be pushed into the raise with hand shovels, but no lifting is required. Mining is started at the end of the crosscut farthest from the shaft by blasting the pillar between the crosscut and the rock or cave. Half the pillar between the crosscut and the next line of raises, with the ore above the crosscut, is blasted down into the raises.

"As soon as the top sublevel has advanced a safe distance, the sublevel immediately below is prepared and opened. From now on, mining is carried in steps from the boundaries to the shaft. The ground should not be prepared much in advance of actual caving, in order to minimize timber repair work and the danger of losing ore from crushed drifts. In putting up branch raises much latitude is permitted. When spaced on the corners of a 10-ft. square, practically all the ore is broken into, or is in such close proximity to raises that shoveling is negligible and other advantages are indicated.

"Certain disadvantages are obvious. Careful supervision is required to hold down dilution of ore with waste and to prevent accidents. Soft, wet ore packs and

"hangs up" in the raises. The method is by no means applicable to all shapes and sizes of orebodies. As the main level is approached, the area covered by raises and branches is decreased. Part of the ore remaining in the "cones" above the level is mined from branch raises put up in the opposite direction. All ore that cannot be reached thus is mined from the top sublevel of the next lower level."

Caving Sticky or Packy Ore

In general, it is desirable to carry the development far enough ahead in wet ground, where the moisture content of the ore is very high, so as thoroughly to drain the stoping area before mining operations start. However, even if this plan is carefully followed, there are instances where sufficient water soaks through an area and does not drain out completely, even though the development work is several years ahead. In ore of this type, the chutes frequently "hang up," and it is difficult to get the ore to run on the average angle of 55 deg. By further inclining the chutes to 65 or 70 deg., this trouble is overcome, except under extreme conditions, where a car must be constantly kept beneath the chute below and continuous drawing practiced.

In most operations, the great secret in overcoming difficulties in mining sticky or packy ore, is to "keep the ore moving." If, for any reason, drawing is temporarily held up, when it is resumed all sorts of difficulties may be encountered.

In the Southwest, in ore deposits containing kaolin, the fines quickly turn to mud when mixed with a slight amount of water, and consequently the branch-raise system is not entirely satisfactory, as the ore packs in the finger raises, and even sticks in the main storage chutes beneath. Continued drawing of heavy ore through the square sets gradually breaks them down. Replacing of timbers in this somewhat inaccessible location, and the delay necessitated by such work, permit the ore to accumulate in the finger raises above, where it packs and will not run. One of the expedients employed to overcome this difficulty is to drive the grizzly drifts only 25 ft. apart, and do all the drawing-off from the grizzly level, rather than from the square set above. This, of course, entails a rather high repair cost in maintaining such close grizzly drifts in heavy ground, but overcomes the delays caused by the square sets breaking down, and allows the ore to keep moving. Also it may be found necessary in such exceptional cases to reduce the height of the ore to be caved, and take a shorter "lift."

In sublevel caving with branch raising in the iron mines of Michigan, similar difficulties are sometimes encountered, as the iron ores pack very readily. On account of the very shallow lift—16 to 20 ft. in height—it is less difficult to keep the ore moving. However, under these conditions the sublevel drifts require considerable repairs, and with the shallower lift the mining cost is, of course, much higher.

Summary and Costs

The branch-raise caving method was brought from the Ohio Copper and developed at Inspiration. It was later introduced at Andes Copper, and more recently at Miami. Variations are also in use at other camps. At Miami, this system finds an ideal application, in that the height of the ore caved is anywhere from 225 to 300 ft., and the ore caves more readily than in any of the other properties where this system is in use.

In the former undercut caving method at Miami, the ore was all measured into cars. With the change of method, this was no longer possible, but the mine organization has standardized operations and developed a high degree of efficiency in its operating force, thereby producing the same satisfactory results as the measuring system did with the old method.

Ores from the Live Oak division of the Inspiration mine contain considerable moisture and kaolin, which causes the caving material to pack, a circumstance which adds difficulty to any rapid drawing system. When drawing was begun in this division, the square sets, grizzly levels, and chutes became heavy in a short time. The same was true of the haulage level. Consequently, many changes had to be made to meet these conditions, such as taking shorter lifts, closer spacing of grizzly drifts, and the drawing of all ore directly on the grizzly level, instead of through the square set above, as formerly. These changes are proving satisfactory and the difficulties mentioned are being overcome.

Costs with the branch raise method vary. The Ruth (Nevada Con.) costs for 1926 were 96.3c. per ton.[4] No costs are available for Braden, but Miami Copper produced its ore during 1926 at a cost of 37c. per ton, plus 0.148c. for general overhead.[4] During early operations, Inspiration's costs were given as 60c. per ton, which included a charge of 20c. for amortization of development expenditure.[5] Of late, costs have been adversely affected by conditions previously mentioned, but, as stated, a solution for these difficulties is slowly being evolved.

What Causes Mine Accidents?

AN EXCELLENT accident record was made in the mines of the Cleveland-Cliffs Iron Company in 1927, according to the company's report. It states that the number of accidents was 41 per cent less than the annual average for many years. In the company's Cliffs Shaft mine there are more than 25 miles of openings in rocks, drifts, raises, and stopes, but in the year mentioned no accidents occurred from rock or ore falling from the back. The company's Republic mine had a similar record. These are both hard-ore mines. At the other mines 34 men were injured by this cause. The explanation given is that the foreman and miners at the soft-ore mines pay less attention to this hazard than is given to it at the hard-ore mines. These accidents can be prevented by carefully inspecting each working place and by compelling the miners to remove loose ground, the report declares. Bars for the miners' use in this work should be provided.

Eighteen men were injured by haulage cars. The report expresses the opinion that men who operate these cars, like many automobile drivers, become careless. Nineteen men were hurt by chunks of ore rolling down dirt piles. But one way exists to prevent such accidents, the report states—namely, make the miners trim the piles so that the chunks cannot roll down. Thirty-two accidents were caused by careless or improper use of axes, saws, and picks by workmen being caught in moving machinery. Some of these latter accidents, however, are regarded as non-preventable. Loading ore at chutes and handling timber are also given as the causes of accidents.

[4]Annual Report, Jan. 1, 1927.
[5]*Min. & Sci. Press*, Sept. 29, 1917.

Pertinent and Practical Observations on the *Theory of Sampling*

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IT IS RATHER remarkable that the extensive literature on sampling, as applied to mineral and metallurgical products, contains but few references to the basal theory of sampling. "Sampling and Estimating Ore in a Mine," by T. A. Rickard, which includes contributions to the discussion of the subject by some twenty-five other engineers as well as the statements of the author, is chiefly devoted to the practical problems of sampling operations. Where theory is discussed it is concerned mainly with computing the volumes to which assay results are to be applied; the authors assume fundamental relations and proceed to discuss their practical application. Sharwood's bibliography of sampling[1] lists 906 titles, very few of which, judging from their wording, are concerned with theory. D. W. Brunton's "Theory and Practice of Ore Sampling"[2] is the best discussion of the fundamental theory that I have been able to find and it is discussed in detail later.

Several engineers have written on the theory of probability in relation to sampling, in some cases attempting to apply hypotheses that are not applicable under the supposed conditions, which were materially different from those assumed in the classical papers on probability, such as those of LaPlace, Gauss, and Quetelet. The inevitable result of such mistaken efforts to generalize is to obscure rather than to illuminate the subject. An engineer recently said to me that he refused to read such articles, on the grounds that no one could cut two samples out of the same groove that would agree within the limits of error mathematically deduced. Probably such an attitude of mind is widespread, and as it is itself a generalization based on an imperfect understanding of the possibilities and limitations of mathematical analysis, a rather elementary discussion of the theory of sampling may be of service.

Obviously, the first thing to start with is the definition of a sample. The New Standard Dictionary says "a portion, part, or piece taken as a representative of the whole; a part selected or taken at random as a fair or average example of the average of the quality of all." The International (1924) says "a part of anything presented for inspection, or shown as evidence of the quality of the whole; a specimen." The Century (1911) says "a part of anything taken at random out of a large quantity and presented for inspection or intended to be shown as evidence of the quality of the whole; a representative specimen." The Philological Society New English Dictionary (1914) says "a relatively small quantity of material, or an individual object, from which the quality of the mass, group, species, etc., which it represents may be inferred; a specimen."

The last seems to be the clearest and most comprehensive definition, and two points in it need emphasis. The first is that the sample is relatively *small* compared to the aggregate that it represents; and the second is that the "quality" of the thing represented can only be *inferred* from the sample. Many people seem to fall into the error of supposing that somehow a sample actually shows the "quality" if it is properly taken. This is another way of assuming that the sample actually *is* representative of that which it represents; but unfortunately, in most instances, this can be only a matter of belief, and the history of business enterprises is strewn with wrecks resulting from such a belief, that the event proved to be mistaken. Samples are like straw votes; the trust in them is wholly based on a belief that they actually represent what they purport to represent.

Objection to the Word "Random"

The words "taken at random," occurring in some of the definitions, are likely to be misleading. Taking a sample at random is a crude attempt at fairness; its purpose is to insure that every unit of the thing represented has an equal chance with every other to be taken as the sample. Taking one lump off a car of ore would be considered by some as taking a sample "at random"; but obviously it does not meet the condition that every unit should have an equal chance of being taken. Only the material on top has any chance of being taken, and of the material on top the lumps have much more chance of being taken than have the fines. It is not really a representative sample of the entire mass, but only a sample of the lumps on the top, which may not be representative of the mass at all. It is best to reject the word "random" altogether, and specify that the sample should be representative.

In attempting to expound the theory of sampling it is necessary to distinguish between sampling for attributes and sampling for variables. An attribute (as used by statisticians) is something which the unit either has or has not; for example, a man either is or is not dead, a

[1] "Bibliography of Literature on Sampling to July 1, 1921." By W. J. Sharwood and M. W. von Bernewitz. Report of Investigations No. 2336, U. S. Bureau of Mines.

[2] *Trans.* A.I.M.E., Vol. 25, p. 826-844, 1896.

woman is native born or of foreign birth. A variable is something which the unit possesses in a varying degree, such as the height of pine trees. Sampling for variables is so much more difficult than sampling for attributes that it will be best to discuss sampling for attributes first. The easiest way to get the general problem before us will be to consider a specific case.

Suppose we want to find by sampling how many "sixes" may be expected, on the average, to turn up when twelve dice, all alike and perfect, are thrown at the same time. This is simple sampling for an attribute, each die either has or has not the six face uppermost at the end of the throw. To follow the discussion it is necessary to forget about the theory of probability. What we want to know is the average number of sixes thrown in throwing twelve dice, and we find it out by sampling; that is, by throwing the dice. The experiment has actually been made, with the following results from 4,096 throws:

Number of Sixes, A	Number of Throws, B	Product, A × B
0	447	0
1	1,145	1,145
2	1,181	2,362
3	796	2,388
4	380	1,520
5	115	575
6	24	144
7	7	49
8	1	8
Total	4,096	8,191

Here 4,096 samples[3] have been taken to find how many sixes turn up on rolling twelve dice. The average of the 4,096 samples is almost exactly two sixes per throw. But on inspecting the results we find that more than one-fourth of the samples gave only one six per throw, and almost one-fifth of the samples gave three sixes per throw; one sample gave eight.

The question immediately arises, what right, if any, have we to reject the sample that gave eight, on the ground that it must be in error because it is too high—four times the average. Theoretically we have no right to reject it, for any number between zero and twelve may be correct, and it is evident from the table that practically we would be unwise to do so, for the average result is more nearly in accordance with theory by including it than it would be if rejected. But suppose we had only rolled the dice three times and got the following results:

Number of Sixes, A	Number of Throws, B	Product, A × B
1	1	1
2	1	2
8	1	8
Total	3	11

If we retain the sample that gave eight, the average is 3.7 sixes per throw; if we reject it the average is 1.5 sixes per throw. Obviously, the difficulty here is that we have not taken enough samples. Is there any way in which we can find out how many samples must be taken to justify belief that the average of their results is accurate?

In considering this problem it is at once evident that the number of samples required to justify belief that their average is representative must be a function of the degrees of difference that can occur. Probably the best modern example of units that are all alike was a Model T Ford touring car; any one of a year's output was a representative sample of them all. The whole idea that lies back of merchandise samples is that the product they represent is uniform in quality and that a single unit or piece can be taken to represent the average. But probably I will be interrupted here by some one who says, "Oh, no; all Fords are not alike. They look alike, but one car will climb hills better than another, and there are perceptible differences in their gasoline and oil consumption, or other characteristics." This is true and illustrates that it is necessary to specify what kind and degree of difference is to be taken into account, or, in other words, what is the purpose of the sampling.

An old story tells of the man who asked a lens maker to make him a glass ruler with a perfectly straight edge. The lens maker replied that he could not make one with a perfectly straight edge, but he could make one with a very low limit of error for $2,000, whereupon it developed that the man merely wanted a transparent ruler for bookkeeping purposes. The two men were thinking about different degrees of difference.

Dice More Docile Than Ford Cars

This discussion is leading away from attributes and into the realm of variables; so let us stick to the dice, as being more easy to manipulate than Fords. Referring to the table, we see that the value of eight sixes in a sample occurred once in 4,096 samples; we have no information as to whether it was the third or the 4,095th sample that gave this value. The question squarely before us is this: if the "quality" of the units taken as a sample ranges between zero and four times the median, how many samples should be taken to justify belief that, from the average of the samples, "the quality of the mass, group, species, etc., which it represents may be inferred"—using the language of the New English dictionary.

There were twelve dice, each having six faces, and they were thrown 4,096 times. The total number of faces involved in the problem were therefore 12 × 6 × 4,096, or 294,912, and the total number shown in the samples 12 × 4,096, or 49,152. It was found by experiment that this number of samples gave an average that agreed with theory, and therefore is believed to be correct. Can we infer from this that samples amounting to one-sixth of what they represent will give a representative average? In the three throws referred to above the total number of faces was 12 × 6 × 3, or 216, and the faces shown in the samples 12 × 3 or 36, or one-sixth of the total number of faces, but the average did not agree with that obtained from the larger number of samples. The difficulty becomes apparent. What we were trying to ascertain was the average number of sixes that would turn up in a large number of throws; 4,096 is a large enough number, so that their "quality" is representative of "a large number," but three is not a large enough number to be representative. It is not the ratio of the number of faces shown in the samples to the number involved in the trials that is important, but the ratio of the number shown to a large indefinite number that might have been shown.

In a single roll of the twelve dice the number of six faces that turn up may be anything from zero to twelve. The average number that turn up in a great number of throws is two. This is comparable to taking a large number of samples from a gold deposit. Suppose that some of the samples show a blank in gold, the highest shows $12 per ton, and the average is $2 per ton.

[3]Most statisticians would prefer to use the word trial rather than sample in this connection, but since the result of a trial is a sample, I prefer to use that word throughout.

But there is an important difference: for in the case of the dice we know that twelve is the maximum value that can occur, whereas in the case of the ore the only maximum limit is a sample of pure gold. There is another equally important difference. With the dice we are dealing with a distinguishable unit, one die, and the sample unit consists of twelve dice. With the sample of gold ore no unit is distinguishable; the sample as first cut is probably made up of a mixture of particles ranging in size from that of a golf ball down to dust particles of nearly microscopic character. This latter fact makes the sampling infinitely more complicated. Let us postpone the discussion of this complication, and first attempt the analysis of the case where twelve is the maximum possible value.

Let us assume that the allowable error in the average is 1 per cent; this might result from a variety of possible reasons; for example, the scales used in weighing the sample might be accurate to only 1 per cent. In practice the allowable error can usually be approximated, and after it has been determined the method of logical analysis would be as follows:

How Many Samples Are Necessary?

The results obtained in a sample may range from zero to twelve. Common sense would indicate that to obtain a representative average would require averaging several times twelve samples. For a guess, let us take fifty samples, assuming that the average of them is two. Suppose the result of a fifty-first sample is twelve, giving an average of 112 ÷ 51, or 2.196. If the average of the first fifty samples was correct the inclusion of the high result has made an error of nearly 10 per cent in the result. Suppose the average of 500 samples is two and the 501st sample gives twelve as a result, for an average of 1,012 ÷ 501, or 2.0199. This is almost exactly 1 per cent difference as compared with the average of the first 500. From this we might conclude that if 1 per cent is the allowable error 500 samples would be enough to determine an average result when the results on individual samples range between zero and twelve in value. Is such a conclusion warranted? Suppose the results ranged from zero to twelve, the average of fifty samples was ten, and the fifty-first sample gave twelve. The average of fifty-one samples is 512 ÷ 51, or 10.04, or only 0.4 per cent different from the result of the first fifty. If fifty samples averaged ten and the fifty-first gave zero the difference would be 2.0 per cent. The effect which a high (or low) result exerts in modifying the average is obviously a function of the amount by which it differs from the average, and the ratio between this difference and the average, as well as of the total number of samples. This conclusion can be expressed in general form, as follows:

Let A be the average of N samples and d the difference between the result of the $(N + 1)$th sample and the average. Then if the average of $N + 1$ samples differs from A by 1 per cent we have the relation

$$A(N + 1) = 100\,d$$

$$N = \frac{100\,d}{A} - 1$$

If the average of N samples is 10 and the $(N + 1)$th sample gives the value fifty, then N must equal 399, if the inclusion of the $(N + 1)$th result is not to affect the average more than 1 per cent.

It is necessary to call attention at this point to the essential difference between the probability of an event and the probable error of a series of observations. Another timely illustration may make this clear. What is the probability that among the men getting on the 8:09 a.m. train for New York at the suburban station of Scarsdale, on Dec. 16, 1928, there will be ten named Smith? This is the probability of an event, and it is obvious that one knows nothing about it unless more facts are given. On being propounded such a question an engineer would immediately run a test. Suppose I had six observers count the Smiths who got on the train this morning, and they reported as follows: ten, eleven, thirteen, eleven, seven, eight. The average of these results is ten. Anyone who remembers his method of least squares well enough can calculate the probable error of that average[4]; those who do not remember and are energetic enough may read the eleven pages devoted to the laws of error in the Encyclopædia Britannica (Eleventh Edition), but the ordinary person will guess that thirteen is the correct figure, and that the five observers who reported a smaller figure missed some of the Smiths.

In other words, mathematics is all right as far as it goes, but it should not be pushed too far. If 13 got on the train today, what is the probability that there will be at least ten on Dec. 16? A lot of factors need to be taken into account; perhaps there was a convention of Smiths today and many who do not ordinarily go to New York, or who usually take other trains, were on that one today. Much mental labor will be saved if we remember to look at the calendar, notice that Dec. 16 is Sunday, and recall that the 8:09 a.m. train does not run on Sundays. Mathematics which does not take all the facts into account may give results that are altogether wrong. The difficulty is not with the mathematics, but the using of it where is does not hold good.

Going back now to the question asked on the previous page, how many samples must be taken, where the maximum value is four times the median, so that the average will not be altered more than 1 per cent by the inclusion or omission of a maximum?[5] Substituting.

$$N = \frac{100 \times 3A}{A} - 1$$

$$= 299$$

That this is a purely mathematical relation based on certain assumptions will be made clear by another assumed case. In a flock of 1,000 birds there are 999 black birds and one white bird, or the percentage of white in the flock is 0.1 per cent. If a hunter shoots ten out of the flock the chances are 99 to 1 that he will not get the white bird and the chances are 99 to 1 that the percentage of white in the sample will be zero. But if the white bird happens to be included in the sample (and it may be), then the percentage of white in the sample would be 10 per cent. On our assumption of a permissible error of 1 per cent in the average, it can vary only between 0.099 and 0.101 per cent. The theory assumes that the average percentage of white in a bird is 0.1 per cent, while in the white bird it is 100 per cent and $d = 99.9$, substituting $N = \frac{100 \times 99.9}{0.1} - 1$

$$= 99{,}998$$

In other words, it is not possible to alter the average value by only 1 per cent by including or omitting the one white bird. The true percentage of white is 0.1 per cent, if the one white bird does not appear in a

[4] It is ±0.6.

[5] The reader must not infer that this equation has any bearing on the probable error of the average, for it has not.

sample of 999 birds the average will be zero; if two white birds appear in a sample of 1,000 the percentage is 0.2, whereas it is only permissible for the average to range between 0.099 and 0.101 per cent.

Application of Theory to Ore

This rather fantastic-appearing illustration is introduced to make clear the logical basis of the article by D. W. Brunton on the theory of sampling, already cited. Mr. Brunton, in his argument, assumes that the sample has been crushed and screened until it will pass a 100-mesh screen and that 2916.6 mg. (one-tenth assay-ton) is taken for analysis. He then computes the effect which one 100-mesh particle of gold, silver, and various gold and silver minerals, if it is in excess of the average, would have on the average value if it is accidentally included in the weight taken for analysis. In the case just cited it made a great deal of difference if one white bird too many was included, because there was only one in the 1,000. If there had been 200 in the 1,000, one more or less would have made relatively little difference. Similarly in the ore sample, one particle of gold or silver too many makes relatively little difference if the average value is high; it may make an appreciable difference if the average value is low. Brunton found that one 100-mesh particle of native gold included in a one-tenth assay-ton sample would make a 1 per cent error if the average value was $5,200 per ton. For a smaller average value it would make a greater difference. But with such minerals as hessite, cerargyrite, argentite, and native silver one 100-mesh particle would not create an error of 1 per cent or more unless the average value was low.

Some confusion may arise because a 1 per cent allowable error in weighing a one-tenth assay-ton sample amounts to ±29 mg. and one 100-mesh particle of gold weighs only 0.26 mg. The assumption is not that there is one *particle* more in the one-tenth assay-ton weight than belongs in it, but that there is one more particle of *gold* than belongs in it. The flock of blackbirds might contain 1,008 birds without making much difference in the average percentage resulting from one white bird to the flock, but one white bird too many seriously affects the average. A one-tenth assay-ton sample of 100-mesh material would contain somewhere between 75,000 and 150,000 individual particles, depending on the specific gravity of the mineral, according to the figures given by Brunton as to the weight of a 100-mesh particle of mineral. A plus or minus error of 75 particles in 75,000 is only 0.1 per cent, if they are average particles. A single particle of pure gold, because it differs so from the theoretical average particle, would make a much greater difference.

Importance of Mr. Brunton's Paper

Since Mr. Brunton's paper is so important, and has been, I believe, much less read than its importance warrants, it may be well at this point to give more of the argument. The second point made in his paper is a discussion of the relation between size of particles and their number to give "equal safety," as he expresses it. Specifically, if you start with 500,000 lb. of ore in lumps weighing 5 lb. each, how can you cut that quantity down to a sample of 100,000 particles weighing 0.04 mg. each without changing the chance of taking or missing any individual particle? The answer is to increase the number of particles by crushing in the same ratio that you decrease the weight in cutting the sample. If you cut 50,000 lb. out of the 500,000 lb. lot you must crush the lumps so each 5-lb. lump becomes ten lumps of ½ lb. each. By crushing the particles so that their number is multiplied in the same ratio as the original weight bears to the weight of the reduced sample before taking the fractional part, the chances of getting high (or low) particles remain the same if the other precautions stated by Mr. Brunton are observed. If the flock of 999 blackbirds and one white bird is too large a quantity to make the analysis on, and you wish to cut a sample of 100 birds for analysis, you must first cut each bird into ten pieces before taking the sample of one bird in ten. If you wish to reduce the sample to ten birds each fragment must again be cut into ten pieces. The true percentage of white in the flock is 0.1 per cent; if a sample of ten is taken without crushing the result will either be 0.0 or 10 per cent, both of which figures are wrong.

Application of Principle to Taking Samples in the Mine

The point made in the preceding paragraph may seem unnecessarily labored, since it is so generally recognized in the cutting down of samples once taken, but it is not so generally recognized that it applies with equal force to the taking of the original sample. If 1,000 samples weighing 200 lb. each are taken from a block of ore weighing 1,000,000 tons, each 200-lb. sample stands as the representative of 1,000 tons of ore. No amount of care in the subsequent handling of the 200-lb. sample can make it more nearly representative of the 1,000-ton block than it was when first cut. How nearly representative it is, can be only a matter of inference.

Restating the question under consideration, suppose a block of 1,000,000 tons of ore to be sampled. How many samples must be taken to be reasonably sure that the average of the results shown by the samples will not differ from the true average of the block by more than 1 per cent?

The first answer is that we can never be sure. Suppose we cut ten slices of 100 tons each out of the block. We can never be sure, in a block where the distribution is irregular, that the material lying between the slices cut does not differ enough from the average of the samples, so the true average is much different. We can, however, infer from the variability of the samples taken whether they indicate that they are sufficient in number or not.

If there is any general theorem that can be applied, I have not yet discovered it. The reasoning to be applied to a specific case is not difficult, however. Suppose 499 samples have been taken, the average of which is A, and the maximum is $6A$. If the 500th sample gives the value $6A$, it will not change the average of the series more than 1 per cent, as shown in the preceding equation. If the value $6A$ has already been obtained five times in the 499 samples, the betting odds that the 500th sample will give the value $6A$ are five to 499. The odds that it will not give a value greater than $6A$ are 499 to one. But suppose that among the 499 samples there is one with the value $10A$. If that value occurs again in the 500th sample it will change the average 3.6 per cent. By this general method anyone can compute the change that another maximum will make in a series of determined values, and what the odds are that a maximum (or minimum) will occur.

The mathematics can be pursued even further, and having determined the average value of the ore as given by the samples taken, having estimated the average oper-

ating cost of mining and milling the ore, and having computed the investment cost on an estimated total quantity of ore, it would not be hard to figure out the probable effect on the profits that would be indicated by getting a value of twice the previous maximum value in the $(n + 1)$ sample. But it must never be forgotten that these are exercises in probability and apply only to so many factors as are considered. Where the grief comes in is through overlooking an important factor, as in the case cited of the train that did not run on Sunday.

In conclusion, it is possible to infer from the results obtained in a series of samples whether the number taken is sufficient to give reasonable odds that another maximum or minimum would not too seriously affect the results. In reckoning odds, however, all possibilities must be taken into account; otherwise the inference will be erroneous.

New Dredge Built for Bangrin Company

A TIN DREDGE, designed by Cutten Brothers, and recently shipped from the yard of Lobnitz & Company, at Renfrew, Scotland, for the Bangrin Tin Dredging Company, Ltd., operating in Siam, is described in the February issue of *The Mining Magazine*. It is said to have some novel features in the tin-concentration plant. The dredge is required for working comparatively shallow ground, the maximum depth being 36 ft., and has a dredging capacity of 100,000 cu.yd. per month. Its hull is 120 ft. long by 48 ft. beam by 8 ft. 6 in. molded depth, and is divided into seventeen water-tight compartments. The plating is doubled at the bow and stern where chafing on the ground and the tailings is likely to occur. Open-connected buckets of 7½ cu.ft. capacity, of a type which has proved eminently satisfactory on an adjoining property, will be used, and the dredge is fitted with an automatic device for scooping stiff clay out of the buckets as they pass over the top tumbler.

The dredge will be electrically driven, power being supplied by the company's own power station, now under construction. Transmission to the dredge will be by 3-phase alternating current at 3,000 volts, the last section of the line being a submersible cable. The current will be stepped down to 400 volts on the dredge. A 200-hp. slip-ring reversible motor will be used to drive the buckets and ladder-lifting winch. Squirrel-cage motors of 140 hp. and 50 hp. respectively will be used to drive the high-pressure and low-pressure centrifugal pumps. A 50-hp. squirrel-cage motor will drive the screen and mooring winch, and a similar motor will drive the shafting for the jigs. Five 10-hp. motors will be used for driving auxiliary machinery.

The drop-chute will be fitted with a sliding lip operated by the ladder, in order to avoid spilling when dredging shallow. The screen will be of the single-plate skeleton-frame type driven by a single friction roller under the upper end, and the screen housing is designed so that the whole of the fines run into a single launder divided at its lower end by a splitting device, so as to assure an even quality of pulp for treatment at each side of the dredge. Arrangements are made for bypassing the screenings to a mud-chute when dredging in barren overburden.

The high-pressure centrifugal pump has a duty of 3,300 g.p.m. against 90 ft. head and feeds the sparge pipe, giving a nozzle pressure of about 25 lb. per square inch. The low-pressure pump delivers 3,500 g.p.m. against a head of 30 ft. for supplying the pressure water of the classifiers and auxiliary water to the jig compartments.

The tin concentration is effected by means of a classifier and jig system. On each side of the dredge there are two Anaconda classifiers, four roughing jigs, and one cleaning jig. The pulp from the screen, which has ⅜-in. perforations, is fed to a large classifier fitted with an adjustable inner cone. The spigot product from this classifier is fed to the two coarse jigs, the overflow going to the desliming classifier, which feeds the two fine jigs. Jigs are so disposed that either of the fine ones can be fed from the spigot of the first classifier if an excess of coarse sands is produced. The first classifier is designed to overflow 2 mm. to 3 mm. sands, according to the amount of pressure water used and the position of the inner cone. The second classifier acts as a deslimer and to carry off excess water. The jigs are of the type in which the pulp flows over the plunger compartment, and the flow is across the larger dimension of the sieve, thus reducing the speed of flow over the sieve. Each compartment is a separate unit with its own eccentric shaft, so that the plunger speed can be varied in the different compartments if desired. The hutches are of cast iron and are interchangeable. The plungers are each operated by two variable-throw eccentrics fitted with a graduated scale of throw. Each compartment is driven by an independent belt from the line shafting. Concentrates will be drawn off from the hutch spigots and lifted by hydraulic elevators to a dewatering cone over the cleaning jigs. Tailings from the roughing jigs will be lifted by bucket elevators into the main tailings chute taking the screen oversize.

The dredge is equipped with three masts and derricks, one amidships commanding the main gearing and top tumbler, and two at the bows for handling the buckets and lower tumbler. These are operated by independent electric winches. It should be added that the electrical equipment has been supplied under the direction of Messrs. Merz and MacLellan.

Hyposulphite Process Passes

THE BLAISDELL Coscotitlan Syndicate, of Pachuca, went into liquidation late in 1927, having worked all the tailing available. The process used consisted of a modification of the old hyposulphite process, the novelty being the adoption of metallic copper as the precipitant, whereby the double salts of hyposulphite formed the cupric-sodium hyposulphite solvent, common in the Russel process. The tailings were valuable chiefly because of their mercury content, and the modification of the hyposulphite process used recovered the mercury in addition to the silver. Blaisdell Coscotitlan Syndicate has shipped during the last several years over 50 per cent of the mercury exported from Mexico.

In An Early Issue

J. R. THOENEN describes how high-grade magnesite is mined on the island of Euboea, near Greece, where common labor commands 25 to 50c. a day.

COMMENT AND CRITICISM

"Fundamental Factors Underlying Electrical Prospecting"

THE EDITOR:

Sir—I have read with much interest Mr. Jakosky's paper entitled "Fundamental Factors Underlying Electrical Prospecting," which appeared in your valued journal of Feb. 11 and 18. While the introductory portion deals with the general principles involved, the major portion of the paper discusses the principles on which the method used by the Radiore Company are based. This method may be characterized by the following points of difference from most other inductive or electromagnetic methods: (1) Much higher frequency is

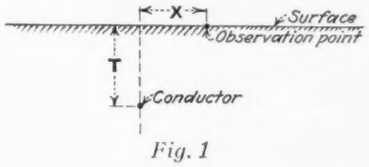


Fig. 1

used (averaging 40,000 cycles, as compared with 2,000 to 500 or less). (2) The frequency is varied during the survey, observations at different points being taken at different frequencies. (3) The method of interpretation of field observations.

Mr. Jakosky describes some serious difficulties encountered because of the comparatively high frequency used, such as "the distortion of primary field" due to surface influence, causing "distortion of wave front" and "phantom dips," which must, of course, seriously affect the interpretation of the results, as he states.

The fact that the frequency is varied from point to point, so that the ellipticity of the field is decreased enough to permit somewhat accurate reading, creates a complication also, because the direction and dip of both the plane of the field ellipse and of its long axis will generally vary with the frequency, making it impossible to correlate the readings. The only advantage for using high frequency mentioned by Mr. Jakosky is "better conductivity" at high frequencies, and so a greater current flow is obtained. But this applies to a moderately conducting overburden as well as to ore. These secondary currents will cause out-of-phase conditions, and the correction of this condition by changing the frequency tends to bring their field 180 deg. out of phase with the primary field, which naturally has the same effect with respect to sharpness of observation as if the fields were in phase.[1] The result, then, is to increase that part of the secondary field due to currents in the overburden (except in desert countries, where the overburden is highly resistant), thus masking the field from any orebody which may be present. The effect of topographical irregularities is also increased, further increasing the difficulty of interpretation. A thorough investigation of these effects was made by us several years ago in northern Sweden under conditions similar to those in Canada. The strength of the secondary field due to an orebody was observed at varying frequencies, and the response was found to be as pronounced at 200 cycles as at 2,000, while at frequencies higher than this it became progressively weaker. It would appear, therefore, that, at least in glaciated regions, the higher frequencies give a less pronounced indication on an orebody, but more pronounced indications on surface irregularities.

Any method of interpreting the observations in electrical prospecting must at least, under simple and ideal conditions, give correct results; otherwise the complications in nature will make the interpretation of field measurements more or less valueless.

The method of interpretation discussed by Mr. Jakosky would appear to give questionable results, even under simple and ideal conditions. Let us consider the case to which Mr. Jakosky's Fig. 5 refers—a secondary linear cur-

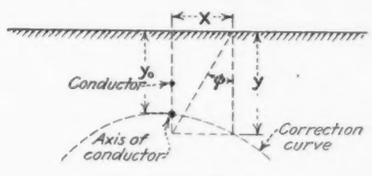


Fig. 2

rent in phase with the primary current in the energizing coil. Assuming this secondary current to be very long, its field at any point at the surface has a vertical component V and a horizontal component H, which in an arbitrary scale are

$$V = \frac{X}{X^2 + T^2} \qquad H = \frac{T}{X^2 + T^2}$$

Where X and T = the distances shown in Fig. 1.

[1]The statement is often made that out-of-phase conditions make accurate determination of the field impossible or more difficult. This is no longer the case, because apparatus is now in use which permits exact readings under any conditions.

The resultant field thus has the components

$$V' = \frac{X}{X^2 + T^2} + \frac{b}{T}$$

$$H' = \frac{T}{X^2 + T^2} + \frac{a}{T}$$

where b = vertical component of primary field in per cent of maximum secondary field, encountered at the sur-

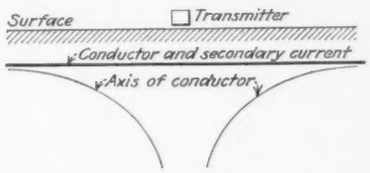


Fig. 3

face, which is $\frac{1}{T}$, and a = horizontal component of primary field expressed in the same way. The resultant field thus makes an angle ψ with the surface, where ψ is determined by

$$\tan \psi = \frac{V'}{H'} = \frac{x.T + b(x^2 + T^2)}{T^2 + a(x^2 + T^2)} \quad (I)$$

Let us first consider the case where $b = 0$ (no vertical component of primary field). The equation for the correction curve shown in Mr. Jakosky's Fig. 14 is in this case

$$y = \frac{X}{\tan \psi} = \frac{T^2 + a(x^2 + T^2)}{T} \quad (II)$$

with the co-ordinates according to Fig. 2:

For x = 0 we obtain

$$y = y_o = T\,(1 + a) \quad (IIa)$$

This is the depth to the conductor, determined according to Radiore's method of interpretation. The depth obtained thus is proportionally larger than the real depth by the ratio a between the horizontal component of the primary field along the traverse line and the maximum secondary field. Now, unfortunately, the primary field, and thus a, varies with different distances from the transmitter, and for small distances from the transmitter the variation is very rapid. As, on the other hand, the secondary field is constant under the assumptions made, the result will be that different depths are obtained along different traverse lines—that is, principally according to Fig. 3.

In the (very ideal and simple) case considered so far, "the electrical axis of the conductor" is to be found outside the conductor, but is at least in the same vertical plane as the conductor.

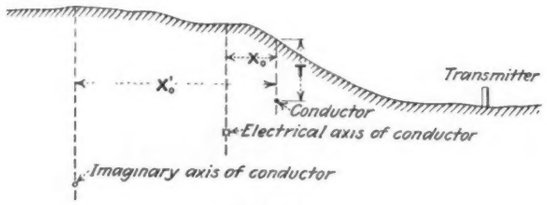


Fig. 4

Let us now consider the case of the primary field having a vertical component, which generally is the case at points above or beneath the level of the transmitter (influence of topography). In this case the "axis of the conductor" is not in the same vertical plane as the conductor, because the axis of the conductor, according to Radiore's method of interpretation, is to be found in the plane where the resultant field is horizontal. Considering relation (I), we find for this point—
$\tan \psi = 0$ and thus $\times T + bx^2 + bT^2 = 0$
which gives

$$X_o = -\frac{T}{2b}(1 - \sqrt{1-4b^2})$$

$$X'_o = -\frac{T}{2b}(1 + \sqrt{1-4b^2}) \quad \text{(III)}$$

Referring to Fig. 4 and relation (III), X_o gives the distance from the conductor to its electrical axis—that is, the error in determining the position of the conductor according to Radiore's method of interpretation. X'_o gives the position of what may be called the "imaginary electrical axis," because it is a point of horizontal resultant field, which does not correspond to any conductor at all, the corresponding indication being due entirely to difference in elevation between the transmitter and the points observed. It is not seen how this method of procedure could reveal the fact that no conductor corresponds to this imaginary axis.

Making the simplified assumption that the vertical component of the primary field is constant along the traverse line investigated, we obtain the following values for X_o and X'_o at different values of b.

Ratio b between vertical component of primary field and maximum secondary field	X_o	X'_o
0	0	Infinity
0.1	$-0.1.T$	$-9.9T$
0.2	$-0.2.T$	$-4.8T$
0.3	$-0.33.T$	$-3.0T$
0.4	$-0.5.T$	$-2.0T$
0.5	$-T$	$-T$

These results are shown graphically in Fig. 5.

The presence of the "imaginary axis," or, in other words, indications corresponding to no conductors but due only to an incomplete procedure, seems very serious.

In the case of b larger than 0.5—if the vertical component of the primary field is larger than 50 per cent of the maximum amount of the secondary field, which is a case which can easily occur in nature, no point is found where the secondary field is horizontal. The presence of the conductors thus is not revealed by this process.

We thus find that serious objections can be made against Mr. Jakosky's method of interpreting results, even in the simple and ideal case of the secondary current being linear and in phase with the primary current. Much more serious must be the objection against using such a method of interpretation under the complicated conditions encountered in practice, because of irregular distribution of secondary currents and the distortions mentioned due to the high frequency and varying frequency used.

In conclusion, I want to indicate clearly that I do not mean to assert that the electromagnetic methods are without value. Our opinion is quite the opposite. We think, however, that the technique which has been discussed above does not always meet the difficulties of the problems presented in nature and can, when used alone, lead to erroneous conclusions.

New York. KARL SUNDBERG,
Swedish-American Prospecting Corporation.

A Tenderfoot's Guide to Mining

THE EDITOR:

Sir—The art of mining has long been practised in this country. In fact, the only reason they discovered this country was that they thought there was gold here, and some people still think so. In the first place, the thing is to get a mine well located. The best location is at the foot of a big mountain, as the mountain makes a good background when you take a picture of the diggings, and one is always thankful that he does not have to climb it. A lot of tenderfeet locate their mines away out in the mountains and sometimes near the tops of the mountains instead of on low ground. If you locate near a good town, or at least on or near a good road, you will have lots of men look at your property, whereas if you locate away out and up high, no one but a real mining engineer will go out there. It sure is disgusting to take a mining engineer away out two or three days' travel and then have him refuse to even take a sample of the budding bonanza.

In order to have a mine it is not necessary that you do any work on the mine, as you can take two weeks' grub and ten pounds of powder out once a year and spend the time smoking and watching the chipmunks play in the day time and listen to the pack rats inspecting your outfit at night. If you see any one around in your part of the hills a couple of sticks of powder on top of a rock makes a lot more noise than when several feet underground and gives the impression that you are hard at work. Some mines look a lot better when there is no work done on them.

Of course you must have some samples, and the best way is to visit a going mine and high-grade a few choice chunks. If you have a showing on your mine you can get some good samples with a little work. By sorting over the best of the ore and trimming it down you can get something that may interest the members of the Hot Stove League in town. You want to get a good assay, too, and the best assays are made by pounding up some of the ore and washing out the waste. Some very good assays may be obtained in this way. If you happen to be an assayer, you can save yourself a lot of work by just using a good lead pencil.

As to the price to ask for a mine, the prevailing price on from one to ten claims is a million dollars. This is generally about $999,999.70 different than the amount the mining men will offer you, but to get any kind of an offer is encouraging. Then you don't have to take what they offer if you have enough to buy grub for another winter. Where a lot of tenderfeet make a big mistake is putting up a mine to pay a grocery bill. In a mining country it is common for the groceryman to have all the best mines.

The main thing is to get a mine. You no more than get it than you begin to learn things about it. You must learn to believe all the stories the other miners tell if you want them to believe what you have got to say. Any one that says anything about your mine not being very valuable doesn't know much about mining. Especially, the ore buyers from the smelters are to be watched, as they will very seldom give more for the ore than they can get out of it.

Steins, N. M. BEN.

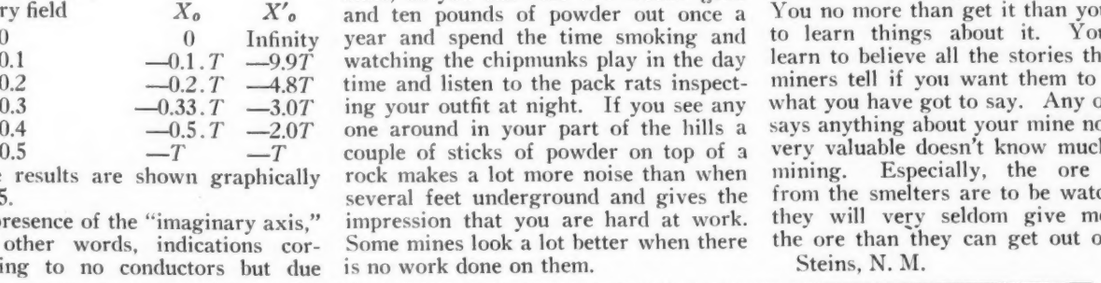


Fig. 5

INDUSTRIAL PROGRESS

How Heat May Be Stored to Advantage in Hot Water Under Pressure

The Steam Accumulator

HOW heat may be stored in hot water under pressure to advantage in many industries was explained by R. A. Langworthy at the recent New York meeting of the American Society of Mechanical Engineers. The fundamental theory of the steam accumulator, which embodies this principle, was presented by Mr. Langworthy, who showed how it might be used to reduce fluctuations of boiler load as well as the production cost of steam where the demands for heat and power vary through wide limits.

The steam accumulator, according to Mr. Langworthy, is a unique piece of power-plant equipment, which, although it has been applied successfully to industrial power development abroad for over ten years, is comparatively unknown on this continent. He uses the term "unique" for the reason that where conditions justify the installation of the accumulator, no other piece of equipment, or combination of equipment, will produce equivalent results.

Although most engineers are familiar in a general way with the principle of heat storage in hot water, and the flashing of such water into steam by lowering the pressure, few realize thoroughly the possibilities that are inherent in the automatic control of such stored heat as well as in the application of such automatic storage to industrial process work.

The principle of heat storage in an accumulator was first developed in Europe, where it was brought about by keen competition and relatively high coal costs. The result has been that more than 300 installations of the steam accumulator have been made in Europe in the last ten years.

It has been customary to accept as unavoidable the variations in the consumption of steam or power in a plant. The attempt made to counteract their effect has been limited largely through providing greater flexibility in the firing apparatus. All firing equipment, however, says Mr. Langworthy, has a certain inherent time lag in responding to changes in load conditions, and during this period the operating efficiency falls off. There is one definite point in the output of steam for each boiler when the over-all efficiency of the unit is at the maximum, the efficiency being less at any other point. Widely separating loads in a boiler plant do more to affect the economical generation of steam adversely than any other single influence. The accumulator makes possible the absorbtion of all fluctuations in demands for steam, regardless of where and when they occur.

At times it is suggested that some of the operations in a plant can be staggered as to time and placed upon a definite schedule, thus partly eliminating the fluctuating steam demand. In most cases, however, this is a compromise, the outcome of which is likely to be doubtful. A more satisfactory solution is reached, Mr. Langworthy asserts, by allowing the process to proceed normally and to meet the steam requirements with an accumulator. Mr. Langworthy is vice-president and general manager of the Ruths Accumulator Company.

The Ruths accumulator is based on the principle of storing in a large quantity of water, under pressure and at saturation temperature, the heat energy of steam, and releasing this energy in the form of steam under decreasing pressure. The principle is not new. It was used by Professor Rateau, according to Mr. Langworthy, but only for the purpose of utilizing over very short periods the intermittent exhaust from steam-driven machinery. The Rateau accumulator had no influence on steam fluctuations in the plant as a whole, whereas the Ruths accumulator provides the storage capacity which will accommodate wide fluctuations in steam demand over periods of hours if necessary. It is in fact, by analogy, the flywheel of the boiler plant.

The steam-storage capacity of water may be demonstrated easily. For example, if a pressure of 400 lb. in a boiler is lowered to, say, 350 lb., it may be shown that 0.8 lb. of steam will be obtained from each cubic foot of water. The steam accumulator can be arranged to work under much lower pressures—say between 60 and 10 lb. For this pressure range a storage capacity of 4.2 lb. of steam per cubic foot of water may be shown. Thus, for the same pressure drop of 50 lb., the storage capacity of the accumulator may be five times larger than in the modern boiler for the same quantity of water. In addition, the boiler in this example has to be built to withstand 400 lb. pressure and the accumulator only 60 lb. Steam storage capacity in an accumulator can therefore be obtained much more cheaply than in a boiler. The figures show that steam boilers should be built only for the purpose of generating steam at a constant rate, and that all necessary water space should be arranged for in a separate receptacle, built

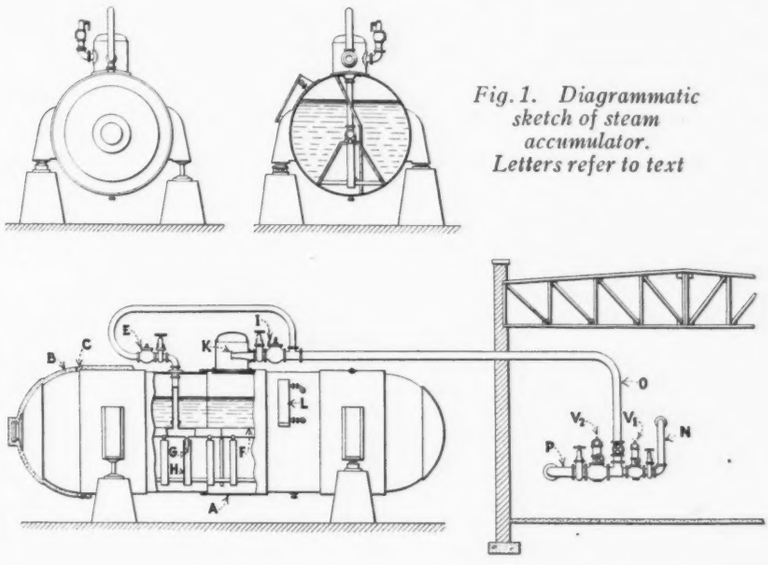
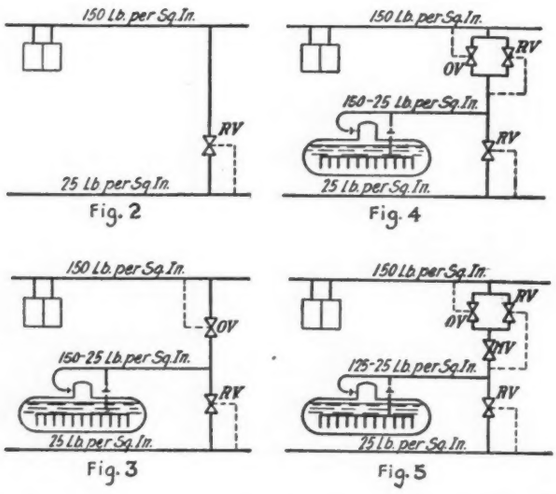


Fig. 1. Diagrammatic sketch of steam accumulator. Letters refer to text



Figs. 2, 3, 4 and 5. Diagrammatic sketches showing boiler plant with and without accumulator installed

for a lower pressure, in which much wider pressure fluctuation may be allowed than in the boiler.

Construction of the Accumulator

The accumulator is built in the form of a cylindrical steel tank with hemispherical ends. It is usually installed in the open air without building protection. A single simple connection is made to the general piping equipment. The plant consists of two parts, the accumulator proper and the automatic regulating valves, which control the co-operation of the boilers and the accumulator and which also govern the steam distribution throughout the whole steam system of the plant.

Fig. 1 shows a complete accumulator installation. The tank *A* is constructed of riveted steel plate and is filled about 90 per cent full of water. Over this is a covering *B* of non-conducting material, with insulation blocks *C* covering the riveted seams of the shell and easily removable for inspection. This lagging is protected by weatherproof covering. The volume is so large in comparison with the exterior surface that an insulation 3 in. thick is sufficient to reduce the heat loss to a negligible amount.

The non-return valve *E* admits charging steam to the internal steam distribution pipe *F* and the charging nozzles *G*, which are equipped with circulation pipes *H* to insure a uniform and noiseless heating of the water. Through a non-return valve *I* the discharge of steam takes place. In case of emergency such as a rupture in the steam piping, a De Laval nozzle *K* limits the maximum discharge of steam from the accumulator to an amount which will not allow priming. A water column *L* is provided for reading and adjusting the water level.

The accumulator shell is supported at four points, so located as to distribute the bearing reactions properly and provide for free expansion under the variations of pressure and temperature of the water it contains.

The capacity of an accumulator for a given load is determined by the magnitude of the fluctuations of the steam consumption only, and not by the capacity of the boiler plant. The volume of the accumulator is a function of the required accumulating capacity and the permissible pressure drop. Steam accumulators have been built in sizes of from 200 to 13,000 cu.ft. in volume.

Automatic Control

Of the highest importance in the proper functioning in the accumulator system is the regulating equipment. The arrangement of the accumulator in the steam plant must be such that it is connected between a high-pressure and a low-pressure steam line. The pressure in both steam headers is always kept constant and the accumulator pressure only is allowed to vary.

Assuming sufficient boiler capacity to meet the average steam demand, it will be seen that when the high-pressure demand is less than this average, the excess steam will be passed into and stored in the accumulator. When peaks occur in the low-pressure steam demand, they will be met from the accumulator. This maintains the low-pressure constant and at the same time, by removing these peaks from the high pressure, maintains the latter constant.

Fig. 2 shows an arrangement often used in industrial plants. Steam is generated in the boiler house at, for instance, 150 lb. per square inch pressure, and reduced by means of a reducing valve *RV* to 25 lb. In most cases, however, the steam supply through *OV* and the steam demand through *RV* are not equal, and there is a difference in time between them. Therefore, a steam storing device—that is, a steam accumulator—capable of storing enough steam to maintain the balance has to be inserted between *OV* and *RV*. If the pressure in the accumulator drops to 25 lb. and there is still demand for steam in excess of the supply from the boilers, the low pressure will drop below 25 lb. To prevent this, a reducing valve *RV* is connected in parallel with *OV* (see Fig. 4) bypassing sufficient steam to maintain the low pressure regardless of the condition of *OV*. Often the accumulator is built for a lower pressure than that of the boilers; for instance for 125 lb. In this case a valve is required which will protect the accumulator from being overcharged; that is, a valve *MV*, Fig. 5, which throttles a supply of steam if the accumulator pressure reaches 125 lb. regardless of the condition of the valves *OV* and *RV*. By using these four valves an absolute balance and constant pressure are maintained, except under extreme conditions beyond the range for which the particular plant has been designed.

In practice the arrangement as shown in Fig. 5 has been improved by combining in a single valve all the functions of valves *OV*, *RV* and *MV*. In Fig. 1 it will be seen that the system consisting of the two automatic regulating valves V_1 and V_2, which control the charging and discharging of the accumulator and maintain constant pressures in the plant steam mains, does everything that the four valves shown in Fig. 5 could do. In the second place, it may be assumed that valve V_1 is connected to the boiler main *N*, and is controlled by the boiler pressure in such a way as to maintain it constant. That is, the valve acts as an overflow valve for the boiler, being set for a pressure slightly lower than that at which the safety valves will open. The popping of the safety valves on the boilers will always be prevented, and when steam is generated in excess of the pressure for which the valve is adjusted, it will automatically pass through this valve into the accumulator line *O*. A reducing valve V_2 maintains a constant pressure in the line *P* leading to the steam consumers. Depending upon whether at a given moment more or less steam is passed through valve V_1 than through valve V_2, the accumulator will be charged or discharged.

In case the accumulator should happen to be charged up to its maximum pressure, V_1 will act as a maximum pressure valve and will shut off further steam supply to the accumulator. On the other hand, if the accumulator should happen to be completely discharged, V_1 will act as a reducing valve, securing a sufficient supply of steam to the secondary steam line *P*, despite the fact that the accumulator is discharged.

The steam accumulator can be built in any required size. It may be used single or in battery. It is impractical in small units because of the cost of the valve control system required.

Installations made to date are reported to show an average saving of around 11 per cent of fuel costs. The cost of upkeep of the boiler setting is also reduced, because of the elimination of violent overloads on the boiler. To date only 17 installations have been made in the United States and Canada, these principally in pulp and paper mills, textile dyeing plants, and sugar refineries. Apparently the system is well adapted for storing excess steam for process use in leaching nitrates, potash, and chrome. It also seems to offer possibilities for carrying peak steam loads in connection with the operation of steam hoists, thawing frozen coal, storing exhaust steam for heating surface buildings, and similar purposes.

NEWS OF THE WEEK

Summary

SALT LAKE Chamber of Commerce passed a resolution recently urging the support of a measure providing for the establishment of a central western experiment station at Salt Lake City. Page 584.

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American commissioner at Paris declares that the British suggestion that a copper consumers' pool be created in Europe to offset American control of production is being seriously considered in Germany. Page 585.

* * *

E. H. Robie found the Oatman district quiet on his recent trip through Arizona mining camps. His description of conditions at this well-known camp may be found on page 586.

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An application for exclusive prospecting rights in Canadian government territory near Hudson Bay has been denied on the ground that other applications would result and the small prospector be discouraged. Page 589.

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Calumet & Hecla is now employing more than 5,000 men at its Michigan properties, reflecting a substantial and steady increase since 1921. Page 587.

* * *

Sudbury is the base metal center of Ontario mining at present. More than 30 diamond drills are being employed in the search for lead, zinc, copper and nickel. Page 587.

* * *

J. H. Duthie purchases control of the Howard mine at Ymir, B. C. Mill construction awaits favorable results from diamond drilling. Page 585.

* * *

Entrance of the Bailey interests into the Barberton district has renewed consideration of the possibilities of this old gold field. Page 589.

Legislation Now Pending Would Eliminate Mine Census Returns

By Paul Wooton
Special Washington Correspondent

LEGISLATION now being considered by the Committee on the Census of the House of Representatives departs from the custom which has prevailed since 1890, in making the necessary authorizations for the census taking every ten years, and eliminates the gathering of returns from mines. The census for 1930, according to the bill, will be restricted "to inquiries relating to population, to agriculture, and to distribution."

Efforts are being made to secure an amendment to the bill which will require the Bureau of the Census to gather information from mines and quarries as well. To do otherwise, it is contended, would leave a gap of twenty years in the figures for the mining industry and would make comparison in the future difficult. The reason advanced for the omission of the mining figures is that the demands of agriculture had become so great that it was necessary to cut down the census reports in other directions. Members of the census committee have been advised that this was done without consulting or advising the mining bureaus of the government.

On the other hand, it is contended that no branch of industry needs statistical services more than does mining. A census of manufacturing industries is taken every two years. In some quarters the possibility of extending the biennial manufacturing census to mines is being considered. It is not improbable that a movement to that end will be launched in the near future.

Oddie War Mineral Bill Substituted for Winter Measure

To facilitate the legislation liberalizing War Minerals Relief, the House Committee on Mines and Mining has substituted for the Winter bill, which it recently approved, the Oddie bill, which has already passed the Senate. The chances of securing the passage of the bill in the House, Senator Oddie states, have been enhanced by the report of the Director of the Budget, who admits that such a law "probably would result in an additional expenditure of several millions of dollars from the federal treasury." This is regarded by advocates of liberalization as an admission from the administration that the courts are likely to view with favor further payments under the War Minerals Relief Act.

Hecla Ore Reserves Sufficient for Eight Years

According to James F. McCarthy, president of Hecla Mining, the ore reserves at the Hecla mine, in the Coeur d'Alene district, are sufficient for eight years of production at present rate of output. The estimate at the close of 1927 totaled 2,538,810 tons. This figure did not include tonnage below the 2,800 level. The zinc plant of Sullivan Mining, in which Hecla has half interest, will be completed in June, according to present expectation.

A contract for 600 ft. of machine drilling on the properties of the Bobby Anderson company on Pine Creek, near Kellogg, Idaho, has been let to Miller & Nelson, of Kellogg. This work should extend the intermediate tunnel to the vein.

H. L. Goodwin has taken over under bond and lease the properties of Big It Mining & Milling, on Trapper Creek, in the Coeur d'Alene district. Active development work is being started. The lower tunnel has already been extended 700 ft. to an intersection with the vein at a depth of 400 ft. The vein contains quantities of quartz with gold, silver, lead, and zinc mineralization.

Mexican Government Making List of Forfeited Properties

The Mexican government is preparing a list of mining properties which have been forfeited during the last year because of failure to pay taxes or comply with other essential provisions of the mining laws. In the list, it is stated, will be found a number of valuable concessions, which for one reason or another have been abandoned by their former owners. The list includes mines in practically every important mining camp in the country. Local agencies are instructed to give to parties interested in reopening the properties full details, as it is the desire of the government to have the mines which may be worth opening in operation soon.

Salt Lake Chamber Requests Increased Appropriations for Bureau Stations

Organization Draws Up Resolution Urging Support of Measure Embodying Features of Several Bills Now Before Congress

A RESOLUTION urging the support of a measure providing for necessary additional financial support for the existing mining experiment stations of the U. S. Bureau of Mines and for the establishment of a central Western experiment station at Salt Lake City was unanimously adopted by the Chamber of Commerce of that city on March 22.

The resolution was sponsored by the mining committee of the organization, the membership of which includes many of the officials of the leading mining and smelting companies operating in the district. J. O. Elton, manager of the International Smelting Company, is chairman of the committee.

The proposed measure embodies in general the provisions of the Smoot, Oddie, and Englebright bills that are now before Congress, and constitutes a program that has been approved by those of the Western mining states who are most directly interested in increased appropriations for the U. S. Bureau of Mines experiment stations. Section 1 of the measure provides for a total annual appropriation of $500,000, of which $50,000 is to be allocated to each of ten mining experiment stations situated at: Tuscaloosa, Ala.; New Brunswick, N. J.; Minneapolis, Minn.; Rolla, Mo.; Salt Lake City, Utah; Tucson, Ariz.; Seattle, Wash.; Berkeley, Calif.; Reno, Nev.; and Moscow, Idaho. Section 2 provides for the erection and completion of a $1,000,000 plant for the Bureau of Mines in Salt Lake City.

Copies of the resolution and proposed measure were forwarded to all Western Senators and Representatives. Letters containing copies of the resolution and measure were sent to influential mining interests throughout the country, urging that support for the proposed legislation be requested of members of the national legislative bodies.

The complete text of the resolution and measure follow:

Be it resolved, by the Chamber of Commerce of Salt Lake City, that the Senators and Representatives from this state be, and they hereby are, requested and urged to support a measure that provides necessary additional financial support for the existing mining experiment stations of the U. S. Bureau of Mines and for the establishment of a central Western experiment station at Salt Lake City, Utah, along the lines indicated in the proposed measure attached hereto:

A Bill

Authorizing appropriations for the establishment and maintenance of mining experiment stations of the United States Bureau of Mines.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, for expenses of mining experiment stations of the United States Bureau of Mines, for the fiscal year ending June 30, 1929, the sum of $327,000, in addition to the sum of $173,000 already appropriated, making a total of $500,000 for the fiscal year ending June 30, 1929; and the sum of $500,000 for each fiscal year thereafter:

Provided, That of the amount appropriated for the fiscal year 1929, $350,000 shall be expended for maintenance of the seven existing mining experiment stations at Tuscaloosa, Alabama; New Brunswick, New Jersey; Minneapolis, Minnesota; Rolla, Missouri; Salt Lake City, Utah; Tucson, Arizona; and Seattle, Washington; $50,000 shall be used for the establishment and maintenance of a mining experiment station at Berkeley, California; $50,000 shall be used for the establishment and maintenance of a mining experiment station at Reno, Nevada, and $50,000 shall be used for the establishment and maintenance of a mining experiment station at Moscow, Idaho, as authorized by the Act approved March 3, 1915 (U.S.C., Title 30, Section 8).

Sec. 2. That the Secretary of the Treasury be, and he is hereby, authorized and directed to enter into contract or contracts for the erection and completion of a plant suitable and necessary for the investigations of the Bureau of Mines in Salt Lake City, Utah, the said plant to be placed on a site acceptable to the Secretary of the Treasury and donated to the United States Government for the purpose; the said plant to cost complete, with the necessary railroad sidings, plumbing, lighting, heating, ventilating, and other general-service equipment, not to exceed the sum of $1,000,000.

Airplane view of the University of Utah, Salt Lake City. The Intermountain Station of the U. S. Bureau of Mines is housed in a portion of the building at the extreme left

Allenby Fire Inquest Elicits New Safety Suggestions

AT THE coroner's inquest into the cause of the deaths of the men killed when the No. 3 bunkhouse at the Copper Mountain mine was burned recently, the jury found that eight men were burned to death in the fire, that one man was killed by jumping from the third story of the burning building, and that the bunkhouse was built in compliance with all existing regulations at the time of its construction (1927). The inquest was held at Princeton, B. C., on March 21. Copper Mountain mine is located at Allenby, B. C., and is the property of Granby Consolidated Mining, Smelting & Power.

The jury recommended that in the future such buildings should be provided with an adequate fire-alarm system; that ropes, fireproof if possible, should be provided at all upper story windows; that receptacles for refuse should be made of metal or other fireproof material and be provided with lids; and that a register of the occupants of all the bunkhouses should be kept in the company's office. The evidence failed to show or suggest that the fire was of incendiary origin. The fact that fires started in No. 2 and No. 3 bunkhouses at approximately the same time, which at first suggested that they had been set, now is believed to be only a strange coincidence. Old tea chests were provided for rubbish on the ground floor, near the door, in each building; it is supposed that either a live cigarette butt or match end started the refuse in these chests on fire.

A small blaze was started in the staff boarding house at the Copper Mountain mine on March 23 by one of the men leaving the current running in an iron that he had been using to press his suit, but was extinguished before it did any damage.

Duthie Purchases Control of Howard Mine

B. C. Silver-Lead-Zinc-Gold Property Will Be Diamond-Drilled Before Starting Mill Construction

J. F. DUTHIE, of Seattle, Wash., has purchased, for a consideration not made public, a 51 per cent interest in the Howard mine, near Ymir, B. C., from J. W. Pomeroy and associates, of Portland, Ore. Mr. Duthie is president and chief owner of Duthie Mines, Ltd., near Smithers, B. C. Mr. Pomeroy had planned to start the erection of a 200-ton mill as soon as the snow was off the ground, but Mr. Duthie has decided to explore for a downward extension of the oreshoot before starting mill construction. A contract for 5,000 ft. of diamond drilling has been let. About 1,000 tons of ore is ready for shipping at the mine. A shoot of silver-lead-zinc-gold ore has been opened by a drift for a length of 300 ft. If the diamond drilling proves satisfactory, the mill, which will include equipment for treatment by flotation, will be started next August.

Construction of a mill is also planned by the Noble Five Mines, a company which has lately taken over the Noble Five mine, at Sandon, B. C. This company has a capitalization of $3,000,000. The mine was purchased by the late James Dunsmuir in 1919 for $250,000 and operated by him until his death. It was optioned about eighteen months ago under lease. During the last year about 1,500 tons of silver-lead-zinc milling ore was shipped to the Trail smelter. A large body of milling ore has been developed by the lessee, and the mill will be erected at an early date.

Kimberley Mines is the name of a new company formed by Porcupine Goldfields Development & Finance for the operation of its options in British Columbia. Porcupine Goldfields has an agreement with the owners of the Stemwinder and North Star mines, at Kimberley, B. C., to take over these properties and work them when metal prices are propitious. Zinc is the chief metal in the ore, and with present low prices for zinc the mine cannot be worked profitably. Kimberley Mines has a capitalization of $2,500,000. No shares will be offered to the public.

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Hyder, in Southern Alaska, Is Center of Activity

THERE is a good deal of activity north of Hyder, Alaska. Century Mines has been organized to take over and consolidate the Daly-Alaska, Alaska-Premier, and Hobo groups. The Daly-Alaska properties, on Salmon Creek, show silver-lead-gold mineralization. Another group of properties on Salmon Creek, known as the Virginia, has been taken over for development by a Canadian company. Work is being resumed by the Adanac Mines Company, whose holdings adjoin the Mountainview. American Mining & Milling, which owns properties on Fish Creek in the same district, is being reorganized.

Peerless Mining is operating a small mill at Thorne Arm, in the Ketchikan district of southeastern Alaska, and shipping the concentrates. A cyanide plant will be installed to extract the gold, according to plans, thus saving freight and smelter charges.

Hirst-Chicagof Mining, of which J. D. Williams is manager, is the only active gold-producing property on Chicagof Island at present. Ore is being opened from the new No. 2 shaft on the 500 level. It is being developed by two drifts, with both faces in ore. Operations at the old Chicagof, which yielded more than $11,000,000 in gold, will be resumed by the Chicagof Development Company, organized in Vancouver, B. C., for that purpose.

A reported strike of gold quartz in a vein exposed for 2 miles near the Copper River Railway in southern Alaska is responsible for a new stampede.

Marion Twin Gold Mining, operating at Willow Creek, has purchased an additional 5-stamp battery from Alaska Juneau Gold Mining, and is installing it. The company also intends increasing the capacity of its water-power plant, with an addition of a 100-hp. Diesel engine for use in winter when the rivers are frozen.

Creation of European Copper-Consumers' Pool Suggested in England

BASIL MILES, American Administrative Commissioner at the Paris headquarters of the International Chamber of Commerce, in his March review of foreign industrial and trade conditions, declares that European cartels deserve study and attention on the part of Americans. "In one sense," he says, "they represent an effort to realize that maximum unit of production and consumption which has been advocated by the American Section of the International Chamber as the most effective means of reducing trade barriers. The European market is too much 'compartmented'—if such a word may be coined to describe the beehive subdivisions of that rich Continent. All agree that American industry could not have expanded so rapidly to its present proportions of prosperity under similar conditions.

"That European cartels will in numerous instances prove to be competitive is to be expected. That they are primarily organized for the development of Europe's normal markets and so to promote European prosperity is, however, the fundamental purpose of their creation. The prosperity of America's best customer is a highly desirable condition. Measures to realize that condition deserve, therefore, a sympathetic and intelligent consideration which must embrace all the circumstances which surround their operation. In fact, there are many who regard the development of European cartels as one of the few practical achievements in the direction of stabilizing European production, which have been accomplished in the last few years—always excepting the steady march toward the general stabilization of currencies.

"British suggestion that a copper consumers' pool be created in Europe so as to offset the American control of production has been noted with interest in Germany, the principal purchaser of American copper. The establishment of a balance of power in the copper market would, according to the proposal, be an effective substitute for the influence which the declining London market formerly exercised. Such a pool would check buyer competition in the manner in which the American rubber pool is expected to act and would add to the stability of the market.

"There is much speculative comment on predictions of a coming conflict between American and European aluminum producers. References to the increasing productivity of the Saguenay plant in Canada take note of its potential production of 180,000 tons a year, equal to present world production, and the low production costs of this plant. It is thought that the pressure of this new source of low-cost aluminum will be principally directed to a struggle with steel for the principal joint markets of the United States.

"On the other hand, the acquisition of American bauxite concessions in Russia, the American water-power concessions in Spain, and the reputed attempt of the American group to buy into the Hungarian Bauxite Trust, a subsidiary of the European Aluminum Cartel, are interpreted as forecasting an inevitable attempt to expand American markets in Europe. Confidence is, however, expressed in the future of European producers. It is pointed out that the European Aluminum Cartel is the least known and most efficient of cartels."

Revisiting Arizona Mining Camps

With E. H. Robie

Continued from issue of March 31

FROM Katherine to Oatman is a two hours' ride, in which the Black Mountains must be crossed twice. The National Old Trails Road now goes through Gold Roads and Oatman. It is a well-graveled highway, outfitted with new signs. The legend "Dip, 300 feet" becomes familiar, for thus is notice given to slow up for the numerous "draws" or cross washes, which may mean a broken spring or cranium if taken too fast. The crop of dead jackrabbits on the highway seems light this year, though perhaps later on, when the tourist traffic becomes heavy, the carnage will assume its usual proportions.

Oatman, suffering from the ravages of two fires and the cessation of operations at the United Eastern and other smaller properties, is a pretty quiet camp. The Tom Reed mill is operating on a small scale, producing about $20,000 a month, taking ore from leasers in the Tom Reed mine and from two or three other small shippers. John E. Shank is managing the property, with Victor Light as resident agent and John White, mill superintendent. An appropriation of $100,000 was recently made for a 1,000-ft. shaft to tap the known ore in the deeper levels of the mine, down to 268 ft. below the level of previous workings. A raise has been completed from the 600 level to the surface, in three 200-ft. sections. There are two compartments 2½x4½ ft. in the clear, and one 3½x4½. Costs for raising are said to have approximated $40 a foot, but sinking the other 400 ft. will probably cost $50 or more. This will take two or three months at least, after which it will probably take another two months to drain the workings. The capacity of the present mill in the past has been a little over 200 tons a day, but it may be necessary to enlarge it if production from the Tom Reed and other surrounding properties becomes as great as hoped. The Tom Reed to date has produced about $17,000,000 and the United Eastern, now entirely closed down, $15,000,000.

Perhaps the most attractive of the other properties under development at Oatman, according to local reports, is the Sunnyside Consolidated, which is sinking a shaft to the 300 level and has some good showings of ore. The Oatman Eastern is down 500 ft. and driving eastward on the vein. The Western Apex is shipping a little to the Tom Reed mill, as is the Gold Roads (controlled by U. S. Smelting), which is being operated by leasers. At the time of my visit, the United American was beginning to sink to the 500. So it will be seen that Oatman has good possibilities of regaining its lost ground as a producer.

Oatman is about 27 miles southwest of Kingman, and Chloride is about the same distance north, or a little west of north. The Chloride Mining Company, of which F. C. Smith is manager, closed its mine and mill at the end of 1927, leaving the camp without a regular producer. Several properties are working on a small scale, among them the New Century, of which W. S. Murray, of New York, is at the head, which is dewatering to a depth of 200 ft. and preparing to sink further. The Tennessee, M. J. Kiley, manager, is doing a little drifting and crosscutting preparatory to sinking; and the Big Tennessee, operating the Schenectady, is also sinking on the Dardanelles claim, the work being in charge of H. L. McCarn. The Payroll property, owned by Thomas B. Scott, of New York, and under the local management of Duval Hampton, is reported to have developed quite a body of ore and is putting in a small pilot mill. The Golconda is continuing its tunnel into the mountain to the east, and the Cashier group just north is also driving a tunnel.

Across the valley from Chloride the Dixie Queen is opening a mine and running a 20-ton mill, and in the White Hills, some 26 miles to the north, the White Hills Silver Mines Company, under the direction of William Mackie, is reported to have attractive showings.

Lest I give a suggestion of divine omniscience in thus mentioning so many properties after a stay of only two and a half days in the district, it should be said that my information regarding much of this work was obtained second hand, but from no less an authority than Anson H. Smith, mining editor of the *Mohave County Miner*, who has the reputation of being the best posted and having the longest memory of anyone thereabouts.

Looking eastward from the summit of the Black Mountains, on the Oatman-Kingman road

However, on a Sunday morning I did accept the invitation of Smiley Jones to go out to Stockton Hill, about 12 miles north, to look over the Comstock silver mine and mill, managed by Frank M. Manson. This property has been taken over by a syndicate backed by Stobie, Forlong & Company, of Toronto, called Old Colony Mines, Ltd., who also have property adjoining that of the A. S. & R. at Buchans River, Newfoundland. The Comstock mill was closed down last November owing to low lead and zinc prices, but there is still a little activity at the mine on the part of leasers, air and powder being furnished by the company for a half interest in the product. The Banner group, which embraces the principal vein system controlled by this company, has been operated off and on for fifty years, the ore occurrence being well understood and the veins persistent. With somewhat higher metal prices, or a larger scale of operation in co-operation with surrounding properties, a profitable enterprise would seem likely. The proposed tunnel through the mountain from Golconda would aid.

A word about the Comstock mill may be of interest. This was revamped for selective flotation a year or so ago, and excellent results were obtained, milling at the rate of 60 or 65 tons a day. I was told the Allis-Chalmers 5x5½-ft. ball mill installed was the second that company made of this type. Water was added after ball milling to secure a 4 : 1 dilution for flotation. Somewhat more return water was used than new, with apparently no harm to the selective results. Mill heads varied greatly, perhaps a fair average being 9 per cent lead, 10 zinc, 3.5 iron, 7 oz. silver, and 0.1 oz. gold. To the classifier overflow was added, per ton of ore, 1 lb. zinc sulphate, 0.25 to 0.3 lb. cresylic acid, and 0.35 lb. xanthate. The pulp then went to a 12-cell M. S. flotation machine, the first one or two cells making a finished lead concentrate; the third, fourth, and fifth cell concentrate returns as feed to the first; the sixth cell acts as a conditioning unit; the seventh and eighth make a final zinc concentrate; and the concentrate from the rest is returned to the sixth. Occasionally, if the first cell was pulling a little too much zinc or pyrite, perhaps 0.1 lb. of cyanide would be added. To the sixth cell, for zinc flotation, was added 1 to 2 lb. of copper sulphate, 1 lb. of lime, 0.2 lb. of xanthate, and 0.25 lb. of gas tar, with a little more cresylic or pine oil for frothing if necessary. The lead concentrate ran 45 to 60 per cent lead and about 7 zinc; the zinc concentrate 45 to 50 zinc and 2 per cent lead; and the tailing almost no lead and 1 or 2 per cent zinc. The ore was an ideal one for flotation, with no complex minerals, so the simple flow sheet gave excellent results. A table, for pilot purposes only, followed flotation. The

zinc concentrate was dewatered in a 3x4-ft. Oliver filter, but the lead settled satisfactorily by itself. Shipments to Kingman were made by 10-ton White trucks by contract.

Perhaps no better way could be desired for spending a Sunday afternoon than to go out in the hills under the warm Arizona sun of early March and pan gold. There is always a lure to the "colors," as even a tenderfoot knows if he has read Service. My trip to the Foothill district, 12 miles south of Kingman, in company with G. W. Gibson, was therefore most pleasant. A pronounced and persistent vein, apparently from 1 to 3 ft. wide and reported to assay in the neighborhood of $20 per ton in gold, occurs as a fissure in the coarsely crystalline granite which is the country rock. I leave to the geologists a more detailed and perhaps more accurate description. Though known for many years, the veins thereabouts have only recently attracted attention, and N. E. Guyot is now making plans for development. The property appears worthy of investigation.

The Leviathan mine of the Molybdenum Corporation of America lies about 30 miles, in a direct line, southeast of Kingman on the eastern rim of the Hualpai Mountains. George L. Felt is in charge. I understand the mill is closed down, pending improvements, but that active production is to be resumed. The mine is well spoken of locally, though transportation is a difficult problem. An occasional carload of feldspar is mined at a deposit a few miles northeast of Kingman, the workings being plainly visible from the train as one approaches the town from the east. Some production of 45 per cent manganese ore is also being made by another property, and a unique deposit of turquoise near Chloride has formerly been a producer. It is owned by G. D. Atlee, of Kingman, who formerly supplied German consumers with this gem material. Mr. Atlee told me the market was excellent for free samples, but he is only anxious to get orders for large lots.

This brings to an end my notes on the district which centers at Kingman. The country is well mineralized and the development now going on can hardly fail to bring forth another good mine or two. With higher silver, lead, and zinc prices, many properties now comparatively idle would be producers.

From Kingman to the next Arizona mining district—Jerome—is a pleasant ride of about seven hours, which, on the less aristocratic trains, one may punctuate with an excellent Fred Harvey dinner for one silver dollar, a meal which, in the East, would cost about two paper dollars. Such is the average American's mania for speed that he prefers the inconvenience, expense, and often indifferent quality of a dining-car meal to a pleasant half hour's respite from traveling in a station dining room of Fred Harvey quality.

Changing trains at Ash Fork, one may reach Clarkdale and Jerome by rail down the scenic Verde River canyon, passing on the left, according to my map, Hell Canyon, which I have no doubt is fittingly named. Or one may go, as I did, to Prescott, stay all night at the new Hassayampa Hotel, and take the 9 o'clock stage over Mingus Mountain to Jerome, a ride of a little over an hour, with a marvelous view from the mountain side.

Jerome is the same old town, clinging to the mountain side, with switchback streets, though a few new buildings, including schools and a hospital, have been added in recent years. From the Connor Hotel to the United Verde offices at the west end of town is only a five minutes' walk, and it is also but a little way up to the great hole in the side of the mountain which marks the former surface levels of the United Verde copper mine, the late Senator Clark's great bonanza. *(To be continued).*

The Tom Reed property, at Oatman

Many Diamond Drills Working in the Sudbury District

CONDITIONS in the Sudbury mining area of northern Ontario are attracting the attention of mining men all over Canada and the United States. The success attendant upon the development of the Errington Mines (Treadwell Yukon), the Sudbury Basin and other properties has tended to make Sudbury and mecca for mining interests. In the last four months, it is learned, upward of 1,000 claims have been staked in the field, which has long led the world in the production of nickel. Difficulty is being experienced in making examinations, owing to the heavy snow, but some interesting samples are being exhibited.

It is estimated that between 25 and 30 diamond drills are now working in the Sudbury district. A lot of drilling is under way to the west of Sudbury Basin. One drill is being operated on ground at the west end of Sudbury Basin by a Minneapolis syndicate. Another is to be started west of there by private Toronto interests. There are two on the Sudbury Basin, and one is to be started soon on ground secured by the Wiltsey Coghlan Company, which is operating in Quebec. One or two are to be started, also, on the ground immediately west of the Treadwell Yukon. This property is said to be owned by Toronto and New York interests. Drilling is also being done underground at the Treadwell Yukon, and in addition there are about a dozen drills on the various outlying properties in the Serpent Basin and other offsets.

Calumet & Hecla Employing More Than Five Thousand

CALUMET & Hecla Consolidated, in the Michigan copper district, now has 5,200 men on its payroll, including the mines, mills, and smelters. Isle Royale, a subsidiary, has close to 500. There has been a steady climb in number employed since 1920. A large number of men formerly employed have returned to the district and many vacant houses have been reoccupied. Among the men newly employed are several from the Pennsylvania coal districts.

No word has yet been received at Seneca relative to the expected reopening of the property. In the event operations are resumed, the No. 2 stamp mill of Lake Milling, Smelting & Refining at Hubbell will again be available for use. It is in good condition to operate at any time. Senaca is in good physical condition, and no new construction will be necessary for some time. The only major item on the program is a new rock house at No. 1 shaft, but the present structure will answer the purpose for a year or two. The rock house at No. 2, of steel construction, is one of the most modern in the district. The pumps have been in continuous operation since the shutdown, and both shafts are dry and ready to resume.

At Calumet & Hecla Consolidated's Ahmeek mine, a plat has been cut at the 37 level and sinking resumed. The vein is showing up well at depth. An extensive opening program is under way in all three shafts. Only one level in Allouez territory is being stoped, but drifting in Allouez ground is proceeding on three levels from the 34th to the 37th. Allouez ground is considerably below that of Ahmeek in copper content.

To drain the lower workings of the conglomerate in Calumet & Hecla, a long drift at the 85th level of A shaft has been holed through to No. 5 Tamarack pump shaft. It winds its way through a tract stoped by the old Tamarack years ago.

Con. Virginia to Work Dumps

Consolidated Virginia Mining Company, of Virginia City, Nev., is dismantling and selling its present equipment and will work the mine dumps. A mill is to be erected. The first carload of equipment for this purpose is on the ground.

American Mining Congress Proposes New Rate for Mine Depletion

ON BEHALF of the mining industry, the tax division of the American Mining Congress has filed a brief with the Senate Finance Committee in favor of a provision in the new tax law allowing depletion for metal mines at the rate of 15 per cent of gross income. It is pointed out that discovery value has been denied the mining industry on ore discovered after March 1, 1913, in cases where the newly discovered ore was part of an existing mine and was to be developed and extracted through existing workings; where the newly discovered ore was an extension of a previously known vein or deposit; and where ore existed, but was held by the Internal Revenue Bureau not to be well enough defined to justify its inclusion in the original valuation; and that the 1926 amendment afforded but little relief.

It is believed that Treasury officials are satisfied that the proposed 15 per cent rate is reasonable as a basis for depletion in the case of all metals. It is stated that this rate will prevent future errors in valuation, such as underestimates of tonnage and errors of judgment in applying factors involved in estimating the present worth of such tonnage as of a basic date. The contention is further advanced that prior returns show that 15c. out of each dollar received from the sale of ore is less than the average depletion allowance for each metal and all metals averaged together. Those familiar with conditions do not believe that the percentage plan will materially affect government revenue.

Toronto Mine Stock Promoter Convicted of Fraud

Fred Reinke, a Toronto mining promoter, was arraigned before Police Magistrate Blake at Brantford, Ont., on March 29 on three charges of obtaining $11,680 by selling stock which proved to be worthless. He pleaded guilty, and admitted that the piece of quartz shown to the people he defrauded did not come from the property he was selling. He was sentenced to six years' imprisonment.

Two Rouyn Properties Are Developing Rapidly

Siscoe Gold Mines has let to the Southwestern Engineering Corporation a contract for the installation of an electrical power plant for mining and milling and 100-ton cyanide plant. It is hoped to have the property in production by November. Development work has blocked out enough ore on the 300 level to keep the mill in operation for eighteen months. The shaft has reached a depth of 475 ft., and sinking is still progressing.

Malartic Mining, in the same district, is also making rapid progress. Operations began last December. The shaft is down to 130 ft. Lateral work has encountered gold over a length of 400 ft. Two diamond drills are in operation, carrying on exploration work at greater depth.

Mexican Labor Situation Continues to Improve

NEWS from Mexico indicates that the labor situation, which a few months ago was very poor, is now being gradually improved. A contract was signed on March 23 between the superintendent of the Peñoles unit at Torreon and local labor representatives for the readjustment of labor agreements along the lines indicated by the secretary of the Department of Commerce, Labor, and Industry. This apparently settles the long-drawn-out labor dispute at Torreon.

The Natividad mine, in Oaxaca, resumed operations recently, according to reports, after a shutdown of several months due to misunderstandings with the workmen. Exploration and development work is being pushed, particular attention being given to operations on the 7 level.

Work has also been resumed at the Majestic, district of Totolapan, in Oaxaca. A short crosscut is being driven to the San Ignacio vein. The heirs to the San Jose Garsona property, also in Oaxaca, are forming a company for the purpose of continuing work. It is stated that the Gerard interests allowed their working option on the property to expire. Active work has started on a new automobile road from Oaxaca City to Tehuantepec, which will open up a number of mines now idle because of transportation difficulties.

Operations at Chontalpan, Guerrero, are reported to be satisfactory to the management of Chontalpan y Anexas. The new flotation plant has a daily capacity of 120 tons. It is expected to have the cyanide plant in operation some time during April. The company is at present handicapped by a shortage of power.

Sierra Mining, operating in Chihuahua, has applied for permission to suspend operations, alleging that the low price of metals and the cost of transportation make it impossible to continue work except at a loss. Sierra has been mining a lead-silver-copper ore, with some gold.

Canadian Associated Goldfields Goes Into Liquidation

Canadian Associated Goldfields, Ltd., operating in the Larder Lake area of northern Ontario, has gone into liquidation, its assets being insufficient to continue operations and to meet maturing liabilities. The court has appointed G. T. Clarkson, of E. R. C. Clarkson Company, of Toronto, as custodian. Shareholders have the right in the bankruptcy proceedings to put forward any plan of reorganization which they or their committees may deem advisable.

New Interest Takes Control of the Champion Mine in Northern Ontario

A NEW organization, known as the Ontario Champion Mines, Ltd., has been formed to take over the operation of the Champion mine, situated in Haycock Township, Kenora district, Ontario. The mine was formerly operated by Champion Gold Mines, Ltd. Capital of the new company is $1,500,000, all in shares of $1 par. It is organized under an Ontario charter and has headquarters at Toronto.

Shaft sinking has proceeded to the 225 level, where 500 ft. of drifting has been done. Equipment on hand includes a pair of Erie boilers, an Allis-Chalmers compressor, and a Bacon hoist, which can work to a depth of 600 ft. There is a test mill on the property to check the value of the ore. Bunk house provides accommodation for 40 men. The water supply for the camp as well as for power house and mill, when erected, can be obtained from Holmes Lake, which is on the property.

United Verde Ex. Exploring Bisbee Queen Property

United Verde Extension has surrendered the options which it held on the Murray claims adjoining the Noranda property in western Quebec. The company carried on exploration work there for over a year, but no ore was found. Exploration work is being continued at the Bisbee Queen property in Bisbee, where drifting is being supplemented by diamond drilling. The drilling is being done by the Continental Diamond Drill Company, of Los Angeles. One hole has reached a depth of 600 ft. The main three-compartment shaft was completed to the 800 level several months ago, and drifts are being driven on the 200, 600 and 800 levels. About 25 men are employed.

United Verde Extension has a substantial sum in the treasury and is making strong efforts to find another mine to take the place of the Jerome mine, whose ore reserves are dwindling. The annual report for the year ending Dec. 31, 1927, shows a net loss of $533,771 after depreciation and depletion, against a profit of $250,314, or 23c. a share on 1,050,000 shares, in 1926.

Manitoba Follows Ontario's Lead in Stock Legislation

Manitoba is following in the footsteps of Ontario with regard to legislation. Mining companies have been removed from the jurisdiction of the "blue-sky" law and will in future be regulated by a law based on the new Ontario act. It is also understood that the Public Utilities Commission, which controls the sale of securities in Manitoba, proposes to limit dealings in shares to members of the Investment Bankers Association, members of the Winnipeg Stock Exchange, or members of well-established firms with a reputation as fiscal agents.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Canadian Government Refuses Application for Concession Near Hudson Bay

TORONTO, MARCH 31, 1928—A good deal of interest, and also opposition, has recently been aroused by the application of a Toronto syndicate for a concession of 5,000 square miles northwest of Hudson Bay in what is known as the Chesterfield Inlet district. This territory is under the jurisdiction of the Dominion government. The applicants were prepared to carry out a campaign of exploration which would involve taking aërial photographs to be turned over to the government. It is understood that they requested exclusive rights in this section for a period of three years, during which they would guarantee to spend $200,000, but agreed to delimit a certain amount of territory each year, which would then be thrown open. The company did not guarantee to stake claims, but if its prospecting showed favorable indications it would under the concession have the first right to take up the number of claims which it would be entitled to stake. Opposition developed as soon as the scheme was made public. It was felt that if this concession was granted other applications would undoubtedly be made, which, with the precedent once established, could not well be refused. As a consequence prospectors might be discouraged and exploration work curtailed. In view of widespread opposition, the government decided not to grant the application.

IN AN EFFORT to facilitate the administration of the new Security Frauds Prevention act, the Attorney General of Ontario is introducing changes in the Companies act designed to fit in with the Security Frauds Prevention measure. Clauses in the present act compelling all companies to file a prospectus will be dropped and a general provision will be introduced requiring all companies to file certain information on a prescribed form. Failure to file this information will make the directors liable to penalties. The bill also empowers the Provincial Secretary to obtain information from any company and provides a penalty if such information is not forthcoming. The provision requiring companies to file shareholders lists will be removed, but under the general provisions the Provincial Secretary may demand such a list whenever he desires it. To limit the number of unnecessary transfers, companies will be given the right to charge a fee of not more than 25c. for the transfer of every certificate.

At the annual meeting of the Abana mine, in the Rouyn section of Quebec, an engineer's report was presented. Developments include 121,000 tons of zinc ore and 202,500 tons of copper ore, or a total of 323,500 tons. The orebodies, which consist largely of high-grade sphalerite and chalcopyrite, occur in a series of volcanic rocks. They are fairly regular and consistent in width, length, and grade. Diamond drilling and electrical surveys are stated to have indicated a total length of 2,800 ft., of which 410 ft. has been developed. It is estimated that it will require another year's development work to determine the nature and extent of the orebodies above the 300 level. At present the construction of a concentrator is under way.

London Letter

BY W. A. DOMAN
Special Correspondent

Chem. & Met. Corporation Meets Success in Treating Platinum Ores

LONDON, MARCH 20, 1928.—One of the features of the last week has been the speculation in the shares of the Chemical & Metallurgical Corporation. This company is erecting works at Runcorn, Cheshire, for the recovery of metals by various processes. The latest, and what is regarded as the most promising, is that dealing with platinum ores, from which a high percentage is reported. In the early days of the platinum discoveries in the Transvaal, I mentioned that Barnato Brothers would have nothing to do with the different companies. At that time the proposition was regarded as too speculative, owing to the difficulties in the treatment of the ores. It was said at the time that Solly Joel would "come in" when the treatment problem had a better chance of success and when companies with inflated values should be on a more reasonable capital footing. It is, therefore, interesting to learn that Solly Joel and his firm of Barnato Brothers have now acquired a block of 250,000 shares in the Chemical & Metallurgical Corporation. This is regarded as an indication that the company's process is likely to prove successful. There are many platinum properties in South Africa and if the recovery is high it may counteract the effect of the decreased value of the metal. When the companies were originally floated, with inflated capitals, platinum was worth about £20 or £22 an ounce. It is now £17, and consequently recovery is the all important factor.

ANOTHER feature is the activity in the shares of Mond Nickel. These are of the nominal value of £1, and have risen to £9. For a time it was difficult to explain the demand for them, as dividend performances did not warrant it. It has since been stated that the full value and more is in the developments of the Frood mine. The company is now capitalized at about £12,000,000.

Johannesburg Letter

BY OWEN LETCHER
Special Correspondent

Interest in Barberton Field Revived by Purchase of Maid of de Kaap

JOHANNESBURG, FEB. 28, 1928.—Interest has been revived in the Barberton gold fields by the recent purchase of the Maid of de Kaap mine by the Bailey interests. These fields, in which the gold occurs most commonly in quartz veins, were worked before the Rand was discovered, but for various reasons the area has recently fallen on comparatively evil days. Bailey Southwell, chairman of Consort Gold Mines, Ltd., represented the Bailey interests in the deal. The Consort mine adjoins the Maid of de Kaap property, and it is intended to work the two together.

For several months the outlook for the gold-mining industry has been obscured by fears of native labor shortage. At present the mines are employing approximately 200,000 natives. Probably 15,000 more will be needed to keep present operations going and provide for programs of expansion such as are contemplated at East Geduld and Daggafontein. Approximately 80,000 of the natives now working are recruited in Portuguese East Africa.

A FEELING of considerable alarm has recently been engendered because of a decree, to go into operation about the middle of this year, which will greatly restrict the supply of Mozambique native laborers to the Transvaal and which may cut off the supply altogether. Portuguese authorities contend that they require all this labor for the development of their own province. In well-informed quarters, however, there is a disposition to believe that the Portuguese threat is connected with the failure of the Union and Mozambique governments to come to terms in regard to a new convention, regulating customs, duties and traffic through the port of Lourenco Marques, and also that the desire of Portugal to raise a loan of £10,000,000 is another material consideration.

Preliminary figures from the office of the government mining engineer show substantial increases in the Union's sales and shipments of copper, tin, and asbestos in 1927, compared with 1926. Copper production increased from 5,681 tons to 7,827 tons and tin from 1,785 tons to 1,929 tons. Value of Transvaal and Cape asbestos sold during 1927 was 241,199, compared with 135,810 in the preceding year. This expansion is mainly due to larger outputs from the New Amianthus mines, controlled by Turner Brothers, of Rochdale, England. At these mines, situated in the Eastern Transvaal, a rope haulage plant is being installed.

Societies, Addresses, Reports

University of Utah Offers New Lecture Course

Practicing Engineers and Geologists Discuss Mining Subjects Before Students

THE FIRST of a series of 32 lectures to be delivered by mining engineers and geologists of the Salt Lake district at the University of Utah, in Salt Lake City, was given on March 21. The lectures will cover prospecting, development of mines, mining methods, sampling, and valuation. They will be open to the students in the mining courses, the faculty of the university, and the general public.

J. J. Beeson, consulting mining geologist, is giving the lectures on prospecting. J. C. Dick, C. T. Van Winkle, and Duncan MacVichie, consulting mining engineers, will discuss the development of mines. The remaining subjects of the course will be covered by H. C. Goodrich, chief engineer, Utah Copper; Paul Billingsley, consulting geologist; J. M. Boutwell, consulting mining geologist; J. W. Wade, assistant general manager, Tintic Standard Mining; and others.

The chief object of the course, as expressed by Dr. Robert H. Bradford, of the mining school faculty, is to present to the students first-hand information concerning the various practical problems encountered in the several branches of the mining engineering profession.

New York Section A.I.M.E. Sees "Story of Iron"

ANOTHER "motion picture evening" was enjoyed by the New York Section of the A.I.M.E., at its annual meeting, March 22, at the Machinery Club, 50 Church Street. Following the dinner, the four-reel motion picture "The Story of Iron" was shown through the courtesy of the U. S. Bureau of Mines, Bethlehem Steel Corporation, Youngstown Sheet and Tube Company, and Pickands, Mather & Company. The film was produced by these organizations, in collaboration. John A. Church, Jr., as chairman, introduced C. Snelling Robinson, vice-president of the Youngstown S. & T. Company, who described and discussed the various operations as they were portrayed upon the screen.

Operations in the iron mines were interestingly explained; the open-pit mines, the "mill-holes" (better known to the non-ferrous metal miner as "glory holes"), and the various underground mining methods were described in detail. Of particular importance was the indicated trend toward mechanization of the various mining methods, of which the increased use of "slushers" or scrapers, in underground mining, is an apt illustration. Present methods of beneficiation were presented briefly. Stock piling of ores, Lake transport, unloading at the Lake docks, blast-furnace charging, tapping, pouring, casting, and ingot stacking were also projected on the screen. Following the picture a discussion of costs and of the tonnages of ore beneficiated was indulged in.

Officers of the New York Section for the coming year were announced as follows: Sidney Rolle, chairman; Arthur Notman and Joseph E. Pogue, vice-chairmen; Lucius Mayer and T. T. Read, committeemen; Colin G. Fink, treasurer; E. C. Meagher, secretary.

Illinois Zinc Holds Its Annual Meeting

AT THE annual meeting of the Illinois Zinc Company, several announcements of importance to the stockholders were made. Among these was the information of the starting of production at the new milling plant of its subsidiary, Peru Mining, located at Hanover, N. M. Illinois Zinc was only engaged in smelting operations at Peru, Ill., prior to 1924. In that year, however it formed Peru Mining, which took over properties in the Tri-State district. The company also owns coal mines near its smelter, thus obviating the necessity for purchasing fuel. The president of the company is L. E. Wemple, Chicago. Other officers are John M. Goetchius, New York, chairman of the board of directors; J. A. Lind, Chicago, secretary; F. A. Warren, Peru, Ill., plants manager; L. E. Nelson, Chicago, sales manager; C. H. Durfee, Joplin, Mo., manager of Tri-State properties; D. M. Stranahan, Hanover, N. M., mining engineer; Sherman Thompson, Peru, Ill., construction engineer; and H. A. Rossell, Deming, N. M., mill superintendent.

Michigan College Offers Twelve Graduate Fellowships

TWELVE graduate fellowships, carrying incomes of $1,200 each, are offered for the academic year 1928-1929 by the Michigan College of Mining and Technology. The holders will be engaged in the study of various problems in connection with the general research program at the college dealing with the iron and copper resources of Michigan. These fellowships are open to college graduates with a bachelor of science degree, or its equivalent, and who are qualified to undertake research in chemistry, geology, geophysics, metallurgy, ore dressing, mechanical engineering or mining. Applications should contain a certified copy of college record, a statement of experience, and names and addresses of at least three references. Aplications must be in the hands of L. F. Duggan, registrar of the college, Houghton, Mich., not later than May 15, 1928.

Mining Supervisors Meet in Washington

THE first conference of Uncle Sam's mining supervisors and oil and gas supervisors since the creation of the Conservation Branch in the U. S. Geological Survey was held in Washington recently.

Under the direction of George Otis Smith, Director of the Survey, assisted by Herman Stabler, chief, John D. Northrop, assistant chief, and H. I. Smith, chief mining supervisor, of the Conservation Branch, this organization has an important place in the conservation and economical development of the mineral resources of the United States. It incorporates all activities of the Geological Survey concerned directly with the classification, use, and disposition of public lands and with the production of minerals on the public domain. It is the consultant and technical assistant of the Office of Indian Affairs in the expanding field of mineral development on Indian lands.

Administration of the work of the branch is decentralized so far as practicable by vesting a large measure of authority in supervisors stationed at strategic points, offices being maintained at Billings, Shelby and Cat Creek, Mont., Casper and Thermopolis, Wyo.; McAlester, Miami, Okmulgee, Shawnee, Cushing, Ardmore, Muskogee, and Tulsa, Okla.; Denver, Colo.; Salt Lake City, Utah; Taft, Calif.; Roswell and Shiprock, N. M.; and Juneau, Alaska. The magnitude of the operations supervised is indicated by the fact that mineral products valued at upward of $140,000,000 a year are developed under them, and about $18,000,000 is paid annually in royalties and rentals.

Safeguarding the public interest in the natural resources of the country is the responsibility placed upon the field representatives of the Department of the Interior, but their informal instructions are to demonstrate in every way that Uncle Sam is the best landlord, since, indeed, from the standpoint of practical conservation, the interests of both landowner and operator are not opposed but parallel. In conformity with federal policy the supervisors and operators alike seek always to avoid premature or wasteful exploitation of mineral resources under their jurisdiction. The close field contact and helpful counsel of highly trained federal representatives serve to promote those sentiments of cordiality and mutual respect between lessee and lessor which underlike all co-operative effort for the common good.

The supervision exercised for the Secretary of the Interior by the Survey's Conservation Branch is closely allied with the continuing task of determining the highest utility of the remaining public lands.

Book Review

MOLDING SANDS AND CEMENT MATERIALS OF KENTUCKY, by C. H. Richardson; and "Geology of the Middlesboro Basin" by C. K. Wentworth.

THIS threefold bulletin, Vol. 29, Series 6, of the Kentucky Geological Survey, Frankfort, 1927, covers a series of very important natural resources of the state. In the molding-sand study co-operation was obtained with a joint committee of the American Foundrymen's Association and the National Research Council. The introductory chapters covering characteristics, specifications, and standard tests of molding sands are particularly valuable in view of the limited literature available on the subject. The sands of nineteen counties were subjected to standard tests at Cornell and the University of Cincinnati, and the descriptions constitute the bulk of the report. In the second section dealing with cement the value of the introductory chapters on the composition and properties of various cements, limes, and plasters is doubtful, as other books cover them in much greater detail and with more accuracy. Some errors have crept in, as, for example, on page 78 the intimation that an excess of 12 per cent impurity is a requisite quality of limestone for the manufacture of lime with slaking properties. The cement raw-material resources of the state are described, together with chemical analyses. The third section of the bulletin deals with the salient features of the bituminous-coal areas in Letcher, Harlan, and Bell counties, in southeastern Kentucky. Reserves of the area are estimated to be more than 4,300 millions of tons. Partial bibliographies are appended to each section of the report.

OLIVER BOWLES.

POOR'S REGISTER OF DIRECTORS OF THE UNITED STATES. Published by the Corporation Trust Co., 120 Broadway, New York. Price $30.

MORE than 60,000 names are listed in this register, each of which is said to be that of a man who is a director or partner in an important business. First his principal business is shown, then all the companies, large or small, in which he is a director or partner. All names are arranged, first, alphabetically for the entire country and then in a separate section by city and state.

QUIN'S METAL HANDBOOK AND STATISTICS, 1928. Published by the Metal Information Bureau, Ltd., 79 Mark Lane, London, E. C. 3, England. Price 5s. net.

This edition marks the fifteenth year of publication of this valuable handbook of metal statistics. It is primarily for use in the United Kingdom, but anyone having to do with metal statistics will find use for it.

STANDARD STEEL & METAL DIRECTORY. 1928 Edition. Atlas Publishing Company, Inc., 150 Lafayette St., New York. Pages 1,000. Price $10.

This directory for years has been a standard reference book in the iron, steel, and metal industry. It is especially valuable to the purchasing agent who may be interested in machinery, equipment, ferrous and non-ferrous metals, and scrap. In addition to other valuable information it contains a comprehensive report on every foundry and steel mill.

AN APPEAL for financial help toward establishing an annotated bibliography of the international literature of economic geology has been made by Dr. Waldemar Lindgren for the National Research Council. A plan for such a bibliography has been worked out and approved by the Council itself, the U. S. Geological Survey, the Bureau of Mines, the A.I.M.E. and the Society of Economic Geologists. It is before several other technical societies, whose approval is expected at their next meeting. The plan includes the establishment of a subscription fund from $18,000 to $24,000, which will provide means for the editorial work for from five to seven years. The Research Council has agreed to serve as custodian of these funds, which are to be expended in accordance with the usual customs of the Council. The Economic Geology Publishing Company has agreed to publish the bibliography, which is to be issued in two volumes per year, aggregating about 400 pages, and to sell it for an equitable price, which will probably be about $2.50 per volume.

Government Publications

CLASSIFICATION — Technical paper No. 403 issued by the U. S. Bureau of Mines, is entitled "Hydraulic Classification, Its Theory, Mechanical Development, and Application to Ore Dressing." The author is A. W. Fahrenwald. Fifty-one pages. Price 15c.* This paper represents work done by the Bureau in co-operation with School of Mines of the University of Idaho. It includes a chapter on methods of determining the densities of liquids and ore pulps.

LEAD, ZINC—"Lead and Zinc Pigments and Salts in 1926," by A. Stoll. 1927. Ten pages, 5c.*

MANGANESE—"Manganese and Manganiferous Ores in 1926," by J. W. Furness. U. S. Bureau of Mines. 1927. Thirty-nine pages. 10c.*

MERCURY—"Mercury in 1926," by J. W. Furness. U. S. Bureau of Mines. 1927. Sixteen pages. 5c.*

POTASH—"Potash in 1926," by A. T. Coons. U. S. Bureau of Mines. 1927. Seven pages. 5c.*

SILICA—"Silica in 1926." U. S. Bureau of Mines. 1927. Five pages. 5c.*

ZINC—"Zinc in 1926," by A. Stoll and J. A. Stader. U. S. Bureau of Mines. 1927. Twenty-one pages. 5c.*

RARE METALS—Bureau of Mines publication on cobalt, molybdenum, nickel, tantalum, titanium, tungsten, radium, uranium, and vanadium in 1926, by Frank L. Hess. Fifty pages. 5c.*

*Sold only by Superintendent of Documents, Government Printing Office, Washington, D. C.

PATENTS

BARITE. No. 1,662,633-4. March 13, 1928. W. O. Borcherdt, at the New Jersey Zinc Company.

These patents cover respectively a method of concentrating barite-bearing material by froth-flotation in the presence of a barite-selective flotation agent containing soap; also a method comprising subjecting the material in the form of a pulp to a froth flotation operation in the presence of cotton-seed oil pitch.

MINE SKIPS. No. 1,662,692. March 13, 1928. John Adsero, Messina, Transvaal, South Africa.

A safety device for mine skips, cages, and the like.

METALLURGY. No. 1,662,811. March 20, 1928. D. W. Bowers, Wilderness, Va.

An open-bottomed vertical cylindrical retort for roasting ores.

SHAKING CONVEYOR. No. 1,662,808. March 20, 1928. E. H. Allfree and A. R. Williams, assignors to the Ironton Engine Company, Ironton, Ohio.

MINE CAR COUPLER. No. 1,662,893. March 20, 1928. John F. O'Connor, assignor to W. H. Miner, Inc.

COMPRESSOR UNLOADER. No. 1,663,214. March 20, 1928. F. A. Muller and L. L. Basberg, assignors to Janet E. Cleary, trading under name of American Air Compressor Works, Brooklyn.

CONICAL CRUSHER. No. 1,663,355. March 20, 1928. C. F. Smith, A. C. Thiele and L. P. Walker, assignors to Smith Engineering Works, Milwaukee.

ROCK DRILL. No. 1,663,403. George H. Gilman, Boston, Mass.

CENTRIFUGAL GRINDING MILL. No. 1,663,881. March 27, 1928. W. A. Gibson and J. C. Burke, Allentown, Pa., assignors to Bradley Pulverizer Company, Allentown.

A centrifugal grinding mill having a horizontal annular grinding ring and a superposed air separating chamber.

MECHANICAL SHOVEL. No. 1,663,917. March 27, 1928. E. C. Morgan, New York.

METALLURGY. No. 1,664,067. March 27, 1928. G. W. B. Evans, Wilderness, Va., assignor to Evans Ore Reduction Company, Washington, D. C.

A process for treating refractory ores containing precious metals which consists in mixing the ore with lime, salt and sal-ammoniac, heating the mixture in an atmosphere of hydrogen while it is being agitated, and separating out the precious metals.

DUMP CAR. No. 1,664,268. March 27, 1928. E. W. Schellentrager, Cleveland, assignor to Atlas Car & Manufacturing Company, Cleveland.

Personal Notes

E. T. McKNIGHT, of the U. S. Geological Survey, left Washington, D. C., on April 2 to resume work on the lead and zinc deposits of northern Arkansas.

CECIL FITCH, general manager of Chief Consolidated, is in Salt Lake City convalescing from the effects of a recent operation.

CHARLES MORGAN, mining engineer, is in charge of operations at the Red Lake Gold Shore property, in the Red Lake area of northern Ontario.

L. B. SLICHTER, a member of Mason, Slichter, & Hay, recently gave a series of five lectures on "Physical Methods of Prospecting" at the Harvard Engineering School.

W. S. BOYD, assistant managing director of Nevada Consolidated Copper, after a visit in Salt Lake City with officials of Utah Copper, is in New York on business.

E. W. TODD is resigning his position as geologist for the Ontario Department of Mines, to take charge of the geological work of the Harker Mines, in the Lightning River area of northern Ontario.

DOUGLAS G. H. WRIGHT, mining engineer, has been engaged in an advisory capacity by the Flintoba Mines, Ltd., which has taken over 21 claims in the Flin Flon area of northern Manitoba, and is preparing for active development.

DR. R. B. STEWART, chief medical adviser for the Hudson's Bay Company, gave an illustrated address on March 25 before the Toronto section of the Canadian Institute of Mining and Metallurgy on "National Resources of the Hudson Bay Basin."

A. H. RICHARDS, of the American Smelting & Refining Company, left Salt Lake City recently to assume his duties as manager of the Tacoma (Wash.) smelter of the company. Mr. Richards was formerly consulting metallurgist of the company.

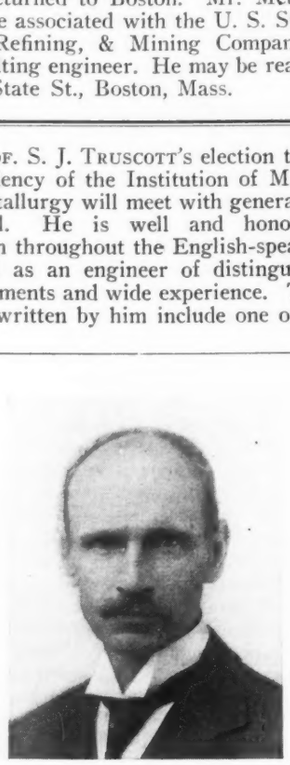
KENNETH WILLIAMS, associated with the Horne Copper Corporation, Rouyn, Que., and formerly professor of chemistry at the University of Utah, visited the university and the Intermountain Station of the U. S. Bureau of Mines at Salt Lake City on March 29.

WILLIAM F. HAYDEN, consulting mining engineer, recently returned to his Salt Lake City offices, having completed for Eastern capital an extended report on the Skiddo mine of Golden Glow Mines, situated in the Wild Rose mining district of Inyo County, Calif.

B. W. DYER, district mining engineer in the Conservation Branch of the U. S. Geological Survey, has returned to his headquarters in Salt Lake City after attending conferences of this branch of the U. S. Geological Survey, which were held recently in Washington, New York, and Pittsburgh.

G. W. METCALFE, for several years general manager of the Fairbanks Exploration Company at Fairbanks, Alaska, has returned to Boston. Mr. Metcalfe will be associated with the U. S. Smelting, Refining, & Mining Company as consulting engineer. He may be reached at 1 State St., Boston, Mass.

PROF. S. J. TRUSCOTT's election to the presidency of the Institution of Mining & Metallurgy will meet with general approval. He is well and honorably known throughout the English-speaking world as an engineer of distinguished attainments and wide experience. Treatises written by him include one on the



PROF. S. J. TRUSCOTT

Witwatersrand goldfields and another on ore dressing. He is also responsible for a translation from the German of a text on ore deposits and for many scattered contributions to contemporary thought in science and technology. His work in the field has included professional activities in many countries, chiefly South Africa, Borneo, Russia, West Africa, Sumatra, and the Celebes. He holds the post of professor of mining at the Royal School of Mines, London, whence he graduated in 1889, with honors. *Engineering and Mining Journal* extends to the new president of the Institution an expression of regard and esteem, confident that during his tenure of office the technical influence and professional traditions of the society will be in safe keeping.

GEORGE I. MACLEAN, assistant financial comptroller of the department of the Interior of the Dominion of Canada, has been appointed gold commissioner of Yukon Territory, with headquarters at Dawson. Mr. MacLean will sail from Vancouver on April 9 for Skagway, en route to his new position.

HIAL GERNERT, a second-year student at the Colorado School of Mines, has been awarded the Women's Auxiliary undergraduate scholarship of the A.I.M.E. for 1928. In addition to his scholastic standing, young Gernert is an outstanding athlete. The 1927 recipient was Fenton Finn, of the Carnegie Institute of Technology.

A. C. WATTS, assistant to the president of the Utah Fuel Company and in charge of the company's operations, has resigned to enter consulting work in Salt Lake City. Mr. Watts, who is a 1902 graduate of the Colorado School of Mines and formerly with the Colorado Fuel & Iron Company, will engage in general mining consulting practice.

C. H. MITCHELL, dean of the faculty of applied science and engineering of the University of Toronto, delivered an address on the development of the Canadian national resources before the Canadian Progress Club on March 30. He drew attention to the possibilities of the ore deposits in Haliburton County, Ont., for the extraction of several of the precious metals, notably radium and platinum.

DR. W. K. STRATMAN-THOMAS has been named fellow under the John Simon Guggenheim Foundation for 1928-1929. Dr. Stratman-Thomas will leave for Africa the latter part of the year to study trypanosomiasis—African sleeping sickness. This disease is not related to encephalitis lethargicus, the sleeping sickness which occurs in the United States. Trypanosomiasis is communicated by the bite of the tsetse fly, which finds habitat in more than a million square miles of Africa.

The caption in the illustration on page 983 of the issue of Dec. 17, 1927, in which Mr. MACLACHLAN, of the staff of Roan Antelope Copper Mines, Ltd., is described as "draftsman," was incorrect in this particular. Mr. MacLachlan is a mining engineer and acting chief surveyor of Roan Antelope. Correction of the designation is made possible through the courtesy of a communication from the Roan Antelope Copper Mines, Ltd.

OBITUARY

J. D. MEENACH, promoter and first president of Mother Lode Copper, died in Seattle recently.

SYDNEY HERBERT PEARCE, reduction manager of the Crown Mines, Ltd., died on Feb. 24, aged 72. He was born and educated in London and went to the Rand in 1889. He was one of the first members of the Chemical, Metallurgical & Mining Society of South Africa, and at different times occupied the offices of secretary and president of the society.

FRANK BULKLEY, former president of the Colorado section of the A.I.M.E., died in Denver on March 25, of heart disease. Mr. Bulkley was born on July 16, 1857. He graduated from the Colorado School of Mines with the degree of E.M., and entered practice as a mining engineer in Denver in 1879. He was a trustee for the Colorado School of Mines for sixteen years.

Market and Financial News

Federal M. & S. Earnings Lower in 1927

FEDERAL Mining and Smelting Company, operating the Morning mine in the Coeur d'Alene district of Idaho, and various properties in the Tri-State district, earned $2,251,705, before depreciation and depletion, in 1927. This compares with $3,638,613 earned in 1926. The Federal company produces silver, lead, and zinc. Consequently, the low prices for those metals in 1927 is largely blamed for the decreased earnings of this company in that year.

Current assets, as of Dec. 31, 1927, were $1,815,053, against $3,702,016 one year before. Current liabilities as of the same dates were $769,585 and $890,911. The accompanying table shows the results of operations for 1927.

Federal Mining and Smelting Company

Net Earnings for the Years Ended Dec. 31

	1927	1926
Value of production	$10,122,172	$12,795,560
Deduct		
Cost of production	4,688,876	5,699,084
Freight and treatment	2,677,419	2,592,743
Royalty	261,888	537,117
Total	$7,628,183	$8,828,945
Net operating earnings	2,493,988	3,966,615
Other earnings:		
Dividends received, interest and rents	223,703	428,978
Total earnings	$2,717,691	$4,395,594
Deduct		
Miscellaneous profit and loss adjustments, general expenses, and federal income taxes	465,985	756,981
Net earnings, before deducting ore depletion and depreciation	$2,251,705	$3,638,613

The earnings of the Morning mine, in Idaho, amounted to $1,893,949, a decrease of $728,269 from 1926. The ore mined amounted to 398,523 tons, being 25,358 tons less than in 1926. The grade of the ore was substantially the same, the average assays being 9.4 per cent lead, 4.8 oz. silver per ton, and 5.7 per cent zinc. This includes the milling ore purchased from leasers.

The mill recoveries showed improvement over those of the previous year, and the grade of both lead and zinc concentrates was raised. These results are tabulated for comparison.

	Grade			Recovery, Per Cent		
	Silver, Oz.	Lead, Per Cent	Zinc, Per Cent	Silver	Lead	Zinc
Lead concentrates, 1926	26.5	63.1	8.3	79.1	85.8	18.4
Lead concentrates 1927	32.6	65.4	8.1	85.6	88.1	17.0
Zinc concentrates, 1926	5.4	4.7	48.6	10.0	4.0	66.8
Zinc concentrates, 1927	4.8	3.2	50.0	9.0	3.2	75.0

No additional ore was developed during the year below the 3,050 level. The 2,850 level was opened for the full length of the ore, and the 3,050 level was opened for a length of 165 ft. The ore had been cut on each of these levels, however, in 1926. The sinking of the shaft for a further depth of 400 ft. was started in December, and two new levels, the 3,250 and 3,450, should be opened in 1928.

Ore reserves at the end of the year were estimated at 1,389,500 tons of developed ore and 330,000 tons of probable ore, a total of 1,719,500 tons. This compares with 2,284,000 tons at the end of 1926, a decrease of 564,500 tons. During the year 398,523 tons of ore was mined. The decrease in the estimate exceeds this by 165,977 tons, and is accounted for by a revision of the estimated tonnage below the 2,650 level, because the 2,850 level, which was opened during the year, while maintaining its grade, showed an average width somewhat less than was estimated a year ago. The 3,050 level, now being opened, shows a greater width, so far, than either the 2,850 or the 2,650 level.

Alaska Juneau

Alaska Juneau Gold Mining Company reports higher gross production for 1927, and operations were somewhat more satisfactory, in general, than in 1926. Comparative summaries follow:

	1927	1926
Gross income from bullion and concentrates	$2,463,432	$2,067,975
Operating expenses, interest	2,425,667	2,098,444
Plant depreciation	189,553	183,946
Net loss before depletion	$151,789	$214,415
Deficit in surplus account, Dec. 31	1,370,026	1,213,460

During the year 314,450 lb. of powder was blasted in the stopes, making a total powder consumption of 0.28 lb. per ton trammed. The record shows that 56.89 per cent of the rock trammed was rejected as waste, and that 4,267,810 tons of ore was produced, averaging $0.77 per ton. Extraction in milling was 3.04 per cent higher than in 1926. Further to increase the extraction, flotation equipment will be installed this year, and it is expected to recover zinc as well as additional gold, silver, and lead.

An average crew of 594 men was employed throughout the year at an average cost per man per day of $9.96. The supply of labor was reported satisfactory.

CRIPPLE CREEK (Colorado) mining district reports gold production for the month of February, of $298,496. The Golden Cycle mill, at Colorado Springs, handled 23,300 tons, with an average value of $10.70 and a gross value of $249,310. The Portland mill at Victor handled 12,677 tons with an average value of $3.88 and a gross value of $49,186.

SPANISH LEAD CONSORTIUM, according to recent foreign cables, has agreed that the government shall adjust the price of lead to meet foreign market prices. The Consortium disposes of a "residence fund" to build up the industry, close mines that are operating unprofitably, and to develop favorable prospects.

GERMAN POTASH SYNDICATE recently announced the production of potash for 1927 as 1,239,372 short tons. In 1926 the production was 1,099,873 short tons.

INDIA imported 99,000 oz. of silver during the week ending March 3. This compares with 1,232,000 oz. during the preceding week.

STATISTICAL NOTES

BETHLEHEM STEEL CORPORATION reports net income, after depreciation and depletion, of $15,826,142 in 1927. This compares with $20,246,167 for 1926. Operations of the corporation averaged 73.6 per cent of capacity in 1927, as compared with 81.1 per cent in 1926. Bethlehem's rated steel capacity, effective Jan. 1, 1928, was 7,900,000 tons. Of the 60,764 stockholders of the corporation, 10,882 were employees and 24,495 additional employees were paying installments on stock. Earnings per hour, of all employees, was 63.8c. in 1927, compared with 62.6c. in 1926.

SAN FRANCISCO MINES OF MEXICO, LTD., treated 24,110 tons of ore in February. From a production of 3,205 tons of lead concentrates and 4,104 tons of zinc concentrate an estimated operating profit of $152,167 was secured.

TRI-STATE ZINC AND LEAD Ore Producers Association reports cost of production of 32,667 tons of concentrates during January, 1928, in 55 mills of the district, as follows:

	Cost Per Ton of Rock Hoisted	Per Cent of Operating Cost	Cost Per Ton of Concentrates	Per Cent of Total Cost
Labor	$0.8890	47.88	$12.8280	33.46
Supplies and repairs	0.2813	15.15	4.0593	10.59
Liability insurance	0.0528	2.84	0.7621	1.99
Explosives	0.1527	8.23	2.2040	5.75
Exploration and development	0.0899	4.84	1.2966	3.38
Power, all classes	0.1788	9.63	2.5798	6.73
Fire and tornado insurance	0.0276	1.49	0.3981	1.04
Management, office salaries and expenses	0.0979	5.27	1.4125	3.68
Taxes (excluding federal income tax)	0.0182	.98	0.2629	.69
Miscellaneous	0.0685	3.69	0.9888	2.58
Total operating expenses	$1.8567	100.00	$26.7921	69.89
Amortization of capital and (depletion)	.....	.....	3.2208	.....
Depreciation	.....	.....	2.1604	.....
Totals	.....	.....	$ 5.3812	14.04
Royalty	.....	.....	6.1591	16.07
Total cost of production	.....	.....	$38.3324	100.00

National Lead 1927 Earnings Off $4,014,148 From 1926 Record

ACCORDING to its annual report for 1927, the National Lead Company's net income was $5,343,639 after preferred dividends, compared with $9,357,787 in 1926. Surplus at the end of the year was $13,245,289, compared with $32,716,746 at the end of 1926 and $27,070,343 on Dec. 31, 1925. Total assets increased from $101,808,385 to $102,215,409 during the year, which compares with $95,931,553 at the end of 1925. Interesting excerpts from the report of E. J. Cornish, president of National Lead Company, include the following:

"Sales of white lead have been satisfactory, equaling the record year 1926. Sales of other products fell off about 10 per cent. Competition is very keen, and in the closing months of the year there were rapidly declining margins of profit in every line. Very serious competition has developed between lead and other metals in lines where lead has for centuries enjoyed deserved prestige—and especially between different pigments used for the same purpose. To meet whatever may have to be met in the line of competition between pigments, the National Lead Company purchased the Titan Company A/S, of Norway, with its mines, plants, processes, and patents for the manufacture of titanium oxide and its compounds. Titanium oxide is interesting in that it has the greatest refractive index of any known white pigment, resulting in hiding power heretofore unattained. It is inert to acid, alkali, and heat. It is still impossible to determine where the greatest demand for this pigment will develop. Probably white lead will sustain its reputation as the best single pigment known.

"All of the foreign investments of the company are satisfactory. Dividends declared by them are included in the earnings. It has been the company's policy to re-invest all of the earnings of the National Lead Company of Argentina in Argentina. This is assisting to develop the mineral resources of that country, and at some time should prove to be a very valuable asset. In the city of Buenos Aires attempts have been made to prevent the use of white lead; but such attempts have not been sustained by the courts and have been frowned upon by the Argentinians of broader vision, who desire the natural resources of their country to be developed."

Silver King Coalition Earnings Largest in History

SILVER KING Coalition Mines Company, operating in the Park City district, Utah, enjoyed a prosperous year in 1927. The annual report, recently issued, indicates that earnings for the year were the greatest in the history of the enterprise, and in the face of an unfavorable metal-market year the record is particularly outstanding. Explanation of the record lies in the fact that a marked appreciation in the grade of ore mined was noted and in the fact that large savings were effected in the mining and milling costs at the mine.

Superintendent Heitzman reports that 14,496 ft. of development work was done during 1927, at a cost of $188,493. Comparison of individual metals produced in 1926 and 1928 are indicated in the following table:

	1926	1927
Gold, oz.	2,773	3,311
Silver, oz.	1,792,300	2,438,256
Copper, lb.	999,671	1,372,536
Lead, lb.	33,911,773	38,128,833
Zinc, lb.	8,421,164	10,318,932

SHANGHAI SILVER STOCKS totaled 112,800,000 taels on March 22, accordinf to a U. S. Department of Commerce radiogram from its Shanghai office. For the previous week, stocks totaled 113,200,000 taels.

Imports and Exports of Ore and Metals in February, 1927 and 1928

Compiled from U. S. Department of Commerce Records
In Pounds Unless Otherwise Stated

Imports

	February 1927	February 1928
Antimony		
Ore { Gross weight	434,108	780,287
Ore { Antimony content	300,616	594,316
Liquated regulus or metal	2,121,996	2,171,582
Copper		
Ores, copper content	4,496,683	6,975,205
Concentrates, copper content	10,043,780	4,151,227
Regulus, coarse metal, cement copper	56,226	265,168
Imported from		
Spain	916,282	758,386
Canada	2,258,804	2,367,997
Mexico	3,318,237	4,304,787
Cuba	6,518,176	1,080,000
Chile	100,097	2,721,823
Peru	71,562	77,673
Other countries	1,414,331	80,934
Unrefined, black, blister, converter copper in pigs, bars, and other forms	33,284,583	41,256,223
Refined copper	8,190,827	561,782
Old and clippings for remanufacture	398,290	894,564
Composition metal, copper chief value	4,780	6,720
Brass, old for remanufacture	713,964	648,384
Ore and matte, lead content	8,940,383	3,653,290
Bullion or base bullion	15,638,770	13,495,552
Pigs and bars	35,270	149
Babbitt, solder and other forms, lead content	47,853	86,874
Type metal, antimonial lead { Gross weight	11,305	327,207
Type metal, antimonial lead { Lead content	8,931	264,557
Manganese		
Cuba, manganese content	2,298	123
Other countries, manganese content	21,585	18,215
Pyrites, tons	.....	.....
Tin		
Ore, tons	5	2
Bars, blocks, pigs	10,537,098	13,422,056
Imported from		
Netherlands	1,176,893	1,433,831
United Kingdom	3,144,401	1,298,000
British Malaya	4,326,313	9,623,335
Netherland East Indies	.....	11,186
Hongkong	1,613,132	697,086
Australia	168,000	123,200
Other countries	108,359	235,418
Zinc		
Ore, zinc content { Free	.....	.....
Ore, zinc content { Dutiable	1,786,371	204,000
Blocks, pigs and old	3,855	100

Exports

	February 1927	February 1928
Copper		
Ores, composition, concentrates, unrefined	1,650	574,959
Refined copper in ingots and other forms	66,805,144	73,061,047
Exported to		
Belgium	4,956,291	9,264,117
France	8,719,841	9,206,049
Germany	17,776,762	23,523,818
Italy	8,902,421	4,619,409
Netherlands	6,943,815	5,934,150
Spain	383,521	.....
Sweden	1,143,641	2,574,445
United Kingdom	11,803,368	16,009,121
Other Europe	168,765	1,092,074
Canada	901,367	111,584
British India	156,822	56,000
China, Hongkong, Kwantung	1,579,200	134,400
Japan	2,743,761	448,025
Other countries	625,569	87,855
Old and scrap	2,332,958	4,479,113
Pipes and tubes	310,766	436,683
Plates and sheets	596,565	472,982
Rods	3,032,422	6,633,243
Wire	1,289,154	1,100,235
Insulated copper wire and cable	1,269,805	1,493,962
Lead		
In pigs, bars, and other forms	.....	.....
From domestic ore	592,365	171,669
From foreign ore	12,863,792	15,880,080
Exported to		
Belgium	560,250	.....
France	280,027	1,232,334
Germany	896,266	5,623,906
Netherlands	235,000	952,206
Sweden	1,030,726	568,641
United Kingdom	4,482,172	3,360,913
Other Europe	.....	728,256
Brazil	168,101	448,007
Other South America	1,101,401	521,293
China, Hongkong, Kwantung	1,569,156	336,225
Japan	2,968,961	2,073,279
Other countries	164,097	206,689
Other lead manufactures	932,702	1,051,615
Zinc		
Ores and concentrates, tons	200	112
Dross	801,377	1,530,634
Cast in slabs, blocks, and pigs	8,252,232	4,250,498
Exported to		
Belgium	425,652	512,006
France	56,001	448,173
Germany	259,198	1,299,288
Italy	1,232,410	291,334
Netherlands	87,728	179,183
United Kingdom	4,772,791	470,525
Other Europe	135,050	325,087
British India	112,040	.....
Japan	448,050	896,096
Other countries	723,312	228,806
Sheets, strips other forms	593,214	2,125,998
Dust	293,380	213,170
Other zinc manufactures	121,770	50,771

The Market Report

Activity in Lead Bright Spot in Metal Markets

New York, April 4, 1928.—The only metal in the non-ferrous group that has enjoyed an active market during the week ending today is lead. Buying was particularly brisk at higher prices established on Monday. Following a phenomenally big week from the standpoint of volume of sales, the copper market quieted down, and sales have been very light. Zinc continues dull, though prices are a little better. Tin is inactive, with little net change in prices. Moderate activity is reported in quicksilver, with a tendency toward firmer prices on a parity with the equivalent of the foreign price of £21 10s f.o.b. European shipping points. Silver has been quiet and steady.

Daily Prices of Metals

March / April	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	13.95	52.50	53.125	6.00	5.85	5.675@5.70
30	13 975	53.25	53.875	6.00@6.05	5.85@5.90	5.65 @5.70
31	13.975	53.375	54.00	6.00@6.05	5.90	5.65 @5.70
2	14.00	.....	53.75	6 10	5 95	5.70
3	13.95@14.05	.....	53.375	6.10	5.975	5.725
4	13.95@14.05	.....	53.25	6.10	5.975	5.725
	13.983	.....	53.563	6.058	5.921	5.698

Average prices for calendar week ending March 31, 1928, are: Copper, 13.929; 99 per cent tin, 52.667; Straits, 53.313; N. Y. lead, 6.008; St. Louis lead, 5.852; zinc, 5.685; and silver, 57.229.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

March / April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	61 13/16	61 15/16	66 1/4	238 1/2	238 1/2	20 1/2	20 1/2	25 1/16	25
30	61 15/16	62	66 1/2	239	238	20 3/16	20 1/2	25	24 15/16
2	61 15/16	61 15/16	66 1/2	241	239 3/4	20 1/2	20 7/16	24 15/16	24 7/8
3	61 7/8	61 7/8	66 1/2	239 3/4	239 1/2	20 1/4	20 5/8	24 15/16	24 15/16
4	61 7/8	61 15/16	66 1/2	238 1/2	239 1/4	20 1/4	20 5/8	24 15/16	25

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4.87 3/4	57 1/4	26 7/16	84s10 1/2d	2	4.87 3/4	57	26 5/16	84s11 1/2d
30	4.87 5/8	57 1/4	26 3/8	84s11 1/2d	3	4.87 3/4	57 1/8	26 1/4	84s11 1/2d
31	4.87 11/16	57 1/4	26 7/16	.....	4	4.87 13/16	57 1/8	26 5/16	84s11 1/2d
					Avg.		57.167		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for March, 1928

COPPER:	
New York Electrolytic	13.845
London Standard Spot	61.148
London Electrolytic Spot	66.443
LEAD:	
New York	6.000
St. Louis	5.805
London Spot	19.938
London Forward	20.352
SILVER:	
New York	57.245
London	26.329
Sterling Exchange	487.558
ZINC:	
St. Louis	5.624
London Spot	25.082
London Forward	24.972
TIN:	
99 per cent	51.630
Straits	52.220
London	232.722
QUICKSILVER	122.557
ANTIMONY	10.083
PLATINUM:	
Refined	80.000
Crude	70.000
ALUMINUM, 98 PER CENT	24.300

Copper Nominal at 14¼c., Valley

The total volume of copper sold during the week is only about one-eighth of the extraordinarily large total of the preceding week. A number of sales were closed last Thursday and Friday at 14⅛c. which had been put under option on Wednesday. Likewise, on Friday a good tonnage was placed at 14.175c. delivered. However, the large primary producers advanced their price to 14¼c. either on Thursday or Friday, and have been holding firmly at that level since. Most of the transactions in the present calendar week were for Middle West delivery at 14⅜c., although several small sales were made in the Valley at 14¼c. and one good order was placed at 14.175c. It is natural that consumers are well supplied following three weeks of better-than-average buying and the short but phenomenal buying wave of last week. At the same time, sellers are in a much easier position, and, encouraged by the success of their policy of staying out of the market until they could obtain their price, they are generally optimistic.

Copper Exporters, Inc., has maintained its foreign price at 14.50c. c.i.f. European destinations, and buying has been excellent so far this month. The narrowing of the spread between the foreign and domestic prices, because of the fact that Copper Exporters has refrained from advancing the foreign price, appears to have stimulated buying.

Lead Active at the Advance

Often in the past an advance in price has been more of a stimulant to trade than a decline, and that condition obtained this week. Following several weeks of better-than-average buying, the American Smelting & Refining Company on Monday, April 2, advanced its

contract price for New York lead from 6 to 6.10c. Consumers evidently thought further advances not unlikely, so they hastened to place their orders, with the result that an exceptionally large business was booked by the chief sellers. All classes of buyers apparently entered the market. Most of the demand was fairly well distributed between April and May shipment, indicating that buyers are providing themselves with lead somewhat further ahead than has been their recent custom. Most of the buying in the last week has been in the East, a fact emphasized by the two chief sellers.

Though some producers have already sold most of their April production, there is apparently plenty of lead in American stockpiles to meet any possible current demand. Production statistics do not indicate any curtailment, and if one is to believe the manufacturers of lead products, consumption of the metal will not be particularly encouraging this spring.

Zinc Remains Quiet

Only a limited tonnage of zinc has been sold during the week. A fair tonnage was placed at 5.70c., but those sellers are now asking more—and getting it in some instances. There is, however, little pressure to sell on the part of producers. At current prices for concentrate in Joplin there is little profit for smelters at prevailing price levels for slab zinc. On the other hand, reports of the American Zinc Institute indicate a considerable volume of sales for future delivery, so that galvanizers apparently are fairly well covered.

Tin Quiet and Unchanged

Little interest has been shown in tin during the last week, and prices are about the same as a week ago, varying between about 53 and 54c. for prompt Straits. Forward positions are one-eighth to one-quarter cent less. As the 99 per cent grade is practically off the market, and promises to continue to be for some time to come, quotations are purely nominal and are, in general, meaningless. Therefore, *Engineering and Mining Journal* will, beginning April 2, 1928, quote only the market for prompt Straits in its tabulation of daily prices.

Silver Closes Quiet and Steady

The silver market has continued steady during the week, fluctuating between 57 and 57¼c. India has been a moderate buyer in the local market, and it is reported from abroad that China has worked both ways. The closing tendency is quiet and steady.

Mexican Dollars (Old Mexican pesos): March 29th, 30th, and 31st, 43⅜c.; April 2d, 43⅝c.; 3d and 4th, 43¾c.

Foreign Exchange Steady

Little change has taken place in Sterling or the other important foreign exchanges. Closing cable quotations on Tuesday, April 3, were: francs, 3.93¾c.; lire, 5.28⅛c.; and marks 23.945c. Canadian dollars are ¾ per cent premium.

Zinc Ore Not Freely Sold at $38

Joplin, Mo., March 31, 1928

Blende	Per Ton
High	$40.95
Premium blende, basis 60 per cent zinc	$39.00@ 40.00
Prime Western, basis 60 per cent zinc	38.00
Slimes and fines, 60 per cent zinc	35.00@ 37.00
Galena	
High	75.00
Basis 80 per cent lead	72.50

Shipments for the week: Blende, 7,200; lead, 936 tons. Value, all ores the week, $344,570.

Buyers have held offerings down to $38 basis all week, and sellers disposed of only about 7,000 tons, with a large majority firm in refusal to accept that price. Lead ore prices are unchanged at $72.50 basis, and only a part of the current week's output has been sold. The daily press rumor that National Lead had taken over the Eagle-Picher Lead is strenuously denied.

Platteville, Wis., March 31, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$40.75
Lead Ore	
Lead, basis 80 per cent lead	$72.50

Shipments for the week: Blende, 669 tons; lead, none. Shipments for the year: Blende, 9,375 tons; lead, 560 tons. Shipments for the week to separating plants: 1,016 tons, blende.

Steel Tonnage Steady—Higher Quotations Nominal

Pittsburgh, April 3, 1928

Tonnage of steel in the first quarter of the year has run almost precisely the same as in the same quarter of the two years preceding. Prices have followed a somewhat different course, as, in the great majority of finished lines, mills have marked prices up, but without actually realizing much advance, as buyers had opportunity to cover at old prices.

With steel ingot production at 83 per cent of capacity in January, 87 per cent in February and, say, 88 to 89 per cent in March, the quarter's total has been about 12,500,000 long tons.

In the three months prior to March, mills had advanced prices on all important finished-steel products except rails, pipe, and tin plate; but buyers had been well covered at old prices for the first quarter, and during March it developed that many contracts had been extended, whereby the advanced prices would have relatively little test for some time, perhaps not until June. The advanced prices have not even held entirely on small current sales.

Steel consumption has been running approximately the same as a year ago, perhaps totaling a trifle less, as with the same deliveries there seems to have been some accumulation of stocks by buyers, particularly in nails and sheets. The automobile industry is running ahead of last year, and line pipe and railroad equipment show losses. Fabricated structural steel lettings have run 10 to 20 per cent ahead in the last quarter.

Pig Iron—The Valley market remains dull, with no change in prices. Bessemer, $17.50; basic, $17; foundry, $17.25 f.o.b. Valley furnaces.

Connellsville Coke—Furnace coke contracts have been renewed for the new quarter at about $2.75. Spot furnace, $2.65@$2.75; spot foundry, $3.75@$4.25, per net ton at ovens.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c. London, 98 per cent, quoted at £100@£105 per long ton for domestic consumption. Largely nominal.

ANTIMONY—Per lb., duty paid: Chinese brands, 9½c., for all positions. Market quiet. Cookson's "C" grade, spot, 16⅜c.

Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c. Nominal.

BISMUTH—Per lb., in ton lots, $2.10. Smaller lots $2.25 and up. London 9s.

CADMIUM—Per lb., 60c. London, 2s. @2s. 1d. for Australian metal.

COBALT—Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 10s. for metal; 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $5.

IRIDIUM—Per oz., $275@$300 for 98 @99 per cent sponge and powder. Market inactive and easier.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $5.

MAGNESIUM—Per lb., in ton lots: 8-lb. ingots (3x3x16 in.), 98c.; 3-lb. sticks (1⅜x33 in.), $0.95@$1; 10-oz. sticks (1x12 in.), 85@90c. Market quiet. London 3s. 9d.@4s. 1d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per gram, 99 per cent, 4c. (Usually sold as calcium molybdate or ferromolybdenum, which see).

MONEL METAL—Per lb. base price for shot, 28@30c., f.o.b. Huntington, W. Va.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.90 per cent grade), for single lots of spot metal. Good demand. London, per long ton, £170@£175 according to quantity. Market fairly active.

OSMIUM—Per oz., $70@$75; London, £15@£18.

PALLADIUM—Per oz., $48@$52. Small lots bring up to $55. London £10¼@£11½. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quoted the trade for refined metal, per oz., $73@$77. Market very quiet.

[1]Price furnished by Foote Mineral Co., Philadelphia.

London, per oz., £17@£17¼ for refined; crude and scrap, nominal.

QUICKSILVER — Per 76-lb. flask, $123@$124. Market steady. San Francisco wires $121. London firm at £22@£22½.

RADIUM — Per mg. radium content, $70.

RHODIUM—Per oz., $62@$67. Nominal.

RUTHENIUM — Per oz., $60@$65. Nominal.

[1]SELENIUM — Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.@ 7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 12c. Nominal.

TELLURIUM—Per oz., 15@18c.

[1]THALLIUM METAL—Per oz.: Ingot, 99 per cent pure, $1.06 in 25-lb. lots.

TUNGSTEN POWDER — Per lb. contained tungsten, 97 to 98 per cent pure, $0.94@$0.96.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

Metallic Ores

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, $22.50@$23.50 for 45 to 50 per cent Cr_2O_3 ore. Prices firm.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 58 to 63 per cent, 8@8½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 11 @11½c., nominal.

Spanish foundry or basic, 50@54 per cent, 8½@9c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@40c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of combined Ta_2O_5 and Cb_2O_5, basis 65 per cent ore, $30.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 93 per cent concentrate, 10c. for 30 ton lots.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.35@$10.60, Western scheelite, $10.40@$10.65. Market showing signs of activity.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $8 in 30 ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest:

Crude No. 1, $650; crude No. 2, $400; spinning fibers, $200@$225; magnesia and compressed sheet fibers, $160@ $175; shingle stock, $90, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $15. Market firm, demand improving.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude, (per long ton) $7. Washed and water floated to 97 per cent through 300 mesh, $19. Shipments steady; production about 80 per cent of normal.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.50, f.o.b. mines. Market fair.

BAUXITE — Per long ton: No. 1 chemical ore, over 55 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 3 per cent Fe_2O_3, $8, f.o.b. *Georgia* mines. Pulverized and dried, $14; calcined, $18@$20.

Per metric ton, foreign, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

BORAX—Per lb.: Carload lots, in bags, crystals, 4c.; granulated or powdered, 3¾c.; f.o.b. plant, Pennsylvania. Market fair.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13.50; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour, No. 1, $20; No. 2, $17. Market slow.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $45@$50.

DIATOMITE — Per short ton, f.o.b plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in. $19@$20; air-floated powder, $45. Over 85 per cent silica, 98 per cent through 200 mesh, $25@$26, depending on quantity. Market fair.

EMERY — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $5@$7.50. Demand fair.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $9. Market fair.

New York, Per ton: f.o.b. cars, No. 1 crude, $9. Market quiet.

Tennessee, per ton: No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 140 mesh, $13.75; 200 mesh, $15.50; demand fair.

Maine, per ton: Best pottery grade, ground, $19. Market fair.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines.

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $14.50@$15. Foundry lump, 85-5, $17. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market very quiet.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 93-3 lump, $21.50. Market good.

Foreign spar, duty paid, $15.50@$16, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh up, $8; 200 mesh up, $14. Market fair at unchanged prices.

Powdered, import duty paid, $24@ $25 per ton.

GARNET — Per ton; domestic, f.o.b. mines, $85. Market easy.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE—Per lb.: F.o.b. *New York*. Market easy.

Ceylon lump, 8@8½c.; chip, 7@7½c.; dust, 3@5½c.; Madagascar flake, 6½@7c. Market quiet.

No. 1 flake, 10c. and up. No. 2 flake, 7c. and up. Foundry facings, 3c. and up. Amorphous and crystalline, fine ground, 3c. and up. Market fair.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25.

[1]Price furnished by Foote Mineral Co., Philadelphia.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$8; agricultural, $6@$10; calcined, $8@$12.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c. Good demand.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 75c.@$2.

Agricultural, $1 up to $4 or $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; Grade B, $38; dead burned, $29; crude, $14. F.o.b. Eastern seaboard, calcined, $40. Market slow.

MICA—Per ton, f. o.b. plant:

New Hampshire: Mine run, $320; clean shop scrap, $25; mine scrap, $22.40. White dry ground, 20 mesh, $25; 40 mesh, $40; 60 mesh, $65; 100 mesh, $75; 200 mesh, $85. Foreign competition and lessened domestic demand are reported to have reduced prices below production costs.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: No. A1, $3.50@$4; No. 1, $3; No. 2, $2.50; No. 3, $1.30; No. 4, 70@80c.; No. 5, 45c. Market fair.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $130.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market improved.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50. Market fair.

Tennessee, ground, 97 per cent through 200 mesh, 33 per cent P_2O_5, $9.50 per ton. Brown lump for acid manufacture, per gross ton, $5.75 on 75 per cent basis; $5 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton). Market active.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent....	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent.....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports; guaranteed 48 per cent sulphur, furnace size, 2½-in. diameter, Spanish, 13c.; Tharsis, 14c. Cinder from ore to remain property of buyers.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 40c. For optical purposes, double above prices; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31: 350 mesh, $26; 250 mesh, $18. Market fairly quiet. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35 @$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per ton for domestic market, $18, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Good shipment against contracts. Open prices $1 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9.50@$10.50; 96½ to 98 per cent through 200 mesh, medium white, $9@$10; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks. Competition keen in less active market.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@ $10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $10 @$12; market fair.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Quiet.

[1]ZIRCON—Per lb., f.o.b. mines in carload lots: 90 per cent, 4½c.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c. Small lots slightly higher. Delivered near by. Quiet. London, per long ton, £17¾@£18 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5@5.10c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude, in bags ex vessel, Atlantic ports, $2.32½ for spot; future delivery, $2.15@$2.17½.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $17@$20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Ferro-Alloys

[1]FERROCERIUM—Per lb., $9 in 15-75 lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $100 for second quarter of 1928. Spiegeleisen, 19@21 per cent, $31@$32 on carload business, f.o.b. furnace. Market stronger.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.25.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River: 50 per cent, $83.50; 75 per cent, $130; 14@17 per cent, $45. Market fairly active.

FERROTITANIUM—Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, 94c., f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, $3.15@$3.65, depending on grade and quantity. Market active.

Metal Products

ROLLED COPPER—Sheets, 23c.; wire, 16c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled, 9¼c. per lb.; clipped, 10c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

ZINC SHEETS — 8½c. per lb., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35 @$38.

MAGNESITE BRICK—Per net ton, f.o.b. works: 9-in. straights, $65.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

[1]ZIRKITE—Per lb.: Powdered, 80 per cent ZrO_2, 3½c. Brick, straights, 80c.@ $1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1927	1928	1927	1928	1927	1928
January	55.795	57.135	25.863	26.313	484.775	487.098
February	57.898	57.016	26.854	26 205	484.551	487.008
March	55.506	57.245	25.655	26.329	484.887	487.558
April	56.399	.....	26.136	.....	485.178	.....
May	56.280	.....	26.072	.....	485.288	.....
June	56.769	.....	26.203	.....	485.183	.....
July	56.360	.....	25.983	.....	485.145	.....
August	54.718	.....	25.224	.....	485.546	.....
September	55.445	.....	25.565	.....	485.878	.....
October	56.035	.....	25.776	.....	486.533	.....
November	57.474	.....	26.526	.....	486.956	.....
December	57.957	.....	26.701	.....	487.714	.....
Year	56.370	.....	26.047	.....	485.636	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1927	1928	1927	1928	1927	1928
January	12.990	13.854	55.414	61.912	62.375	66.575
February	12.682	13.823	54.438	61.670	61.119	66.381
March	13.079	13.845	55.935	61.148	62.641	66.443
April	12.808	.....	55.056	.....	61.526	.....
May	12.621	.....	54.563	.....	60.881	.....
June	12.370	.....	54.030	.....	59.881	.....
July	12.532	.....	54.551	.....	60.089	.....
August	12.971	.....	55.364	.....	62.227	.....
September	12.940	.....	54.455	.....	61.830	.....
October	12.958	.....	55.119	.....	62.256	.....
November	13.319	.....	58.830	.....	63.761	.....
December	13.774	.....	60.078	.....	66.181	.....
Year	12.920	.....	55.653	.....	62.064	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1927	1928	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	7.577	6.500	7.392	6.280	27.485	27.786	21.773	22.213
February	7.420	6.329	7.286	6.069	27.344	27.781	20.283	20.747
March	7.577	6.000	7.328	5.805	27.845	28.302	19.938	20.352
April	7.126	.....	6.807	.....	26.546	27.053	.....	.....
May	6.616	.....	6.269	.....	25.054	25.526	.....	.....
June	6.414	.....	6.150	.....	24.438	24.750	.....	.....
July	6.344	.....	6.120	.....	23.491	23.932	.....	.....
August	6.681	.....	6.367	.....	23.119	23.540	.....	.....
September	6.297	.....	6.044	.....	21.446	21.994	.....	.....
October	6.250	.....	6.013	.....	20.479	20.946	.....	.....
November	6.259	.....	6.035	.....	20.889	21.318	.....	.....
December	6.504	.....	6.319	.....	22.163	22.441	.....	.....
Year	6.755	.....	6.511	.....	24.192	24.614	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	1927	1928	1927	1928	1927	1928
	99%		Straits		Spot	
January	64.785	55.180	66.415	55.650	297.804	253.222
February	66.528	51.793	69.142	52.440	306.125	233.833
March	67.833	51.630	69.199	52.220	313.315	232.722
April	66.069	.....	67.933	.....	302.572	.....
May	63.935	.....	67.510	.....	294.938	.....
June	64.226	.....	67.466	.....	296.006	.....
July	62.625	.....	64.110	.....	288.690	.....
August	63.523	.....	64.431	.....	293.193	.....
September	60.735	.....	61.490	.....	280.432	.....
October	57.560	.....	58.450	.....	264.631	.....
November	57.089	.....	57.641	.....	262.591	.....
December	58.053	.....	58.452	.....	267.138	.....
Year	62.747	.....	64.353	.....	288.953	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	6.661	5.643	30.979	30.938	26.125	26.051
February	6.673	5.551	29.931	30.109	25.518	25.506
March	6.692	5.624	30.649	30.889	25.082	24.972
April	6.338	.....	29.579	29.901	.....	.....
May	6.075	.....	29.034	29.131	.....	.....
June	6.213	.....	28.598	28.613	.....	.....
July	6.229	.....	28.280	28.021	.....	.....
August	6.342	.....	28.210	28.068	.....	.....
September	6.212	.....	27.347	27.327	.....	.....
October	5.996	.....	26.899	26.634	.....	.....
November	5.745	.....	26.281	26.006	.....	.....
December	5.722	.....	26.363	26.109	.....	.....
Year	6.242	.....	28.513	28.479	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
	New York		New York		Refined		Crude	
	1927	1928	1927	1928	1927	1928	1927	1928
					New York			
Jan.	13.910	10.863	101.200	123.620	109.520	79.280	99.820	69.280
Feb.	14.509	10.842	101.727	121.370	107.545	84.783	99.295	74.783
March	12.801	10.083	110.259	122.557	108.000	80.000	100.426	70.000
April	14.166	.....	123.250	.....	101.885	.....	91.865	.....
May	12.975	.....	123.900	.....	84.680	.....	75.000	.....
June	12.447	.....	118.096	.....	72.000	.....	62.500	.....
July	11.880	.....	119.880	.....	72.000	.....	61.520	.....
Aug.	11.826	.....	119.111	.....	72.000	.....	62.000	.....
Sept.	11.073	.....	119.640	.....	72.000	.....	62.000	.....
Oct.	11.165	.....	126.200	.....	72.000	.....	62.000	.....
Nov.	10.763	.....	127.708	.....	72.000	.....	62.000	.....
Dec.	11.195	.....	126.933	.....	72.000	.....	62.000	.....
Year	12.393	.....	118.159	.....	84.636	.....	75.036	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh, and Aluminum 98 Per Cent

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1927	1928	1927	1928	1927	1928	1927	1928
Jan.	19.50	17.50	18.16	17.00	18.50	17.25	26.270	24.300
Feb.	19.02	17.50	18.00	17.00	18.50	17.25	26.000	24.300
March	19.37	17.50	18.28	17.00	18.50	17.25	26.000	24.300
April	19.50	.....	19.00	.....	18.50	.....	26.000	.....
May	19.24	.....	18.24	.....	18.50	.....	26.000	.....
June	18.96	.....	17.96	.....	18.35	.....	26.000	.....
July	18.50	.....	17.50	.....	18.00	.....	26.000	.....
Aug.	18.50	.....	17.32	.....	17.65	.....	26.000	.....
Sept.	18.00	.....	17.11	.....	17.50	.....	26.000	.....
Oct.	18.00	.....	17.00	.....	17.50	.....	25.600	.....
Nov.	18.00	.....	17.00	.....	17.47	.....	25.000	.....
Dec.	17.69	.....	17.00	.....	17.25	.....	24.785	.....
Year	18.69	.....	17.71	.....	18.02	.....	25.808	.....

Iron in dollars per long ton. Aluminum in cents per pound, 98 per cent grade.

New figures, pig iron f.o.b. Mahoning and Shenango valley furnaces, instead of delivered Pittsburgh. Difference from former figures, which were delivered Pittsburgh, $1.76, this being the freight.

Monthly Crude Copper Output in Short Tons

Domestic

	1927				1928	
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Alaska shipments	1,879	4,747	1,402	1,655	2,084	.....
Butte & Superior	†284	.....	.....	†238	.....	.....
Calumet & Arizona	1,807	2,157	2,018	2,065	2,066	2,041
Magma	1,196	1,298	1,404	652	1,300	1,398
Miami	2,008	2,245	2,099	2,932	1,963	1,955
New Cornelia	3,137	3,718	3,613	3,607	3,672	3,267
Nevada Con	†26,298	.....	.....	†26,253	.....	.....
Old Dominion	931	871	832	801	*996	*992
Phelps Dodge††	7,779	7,770	7,799	7,757	8,273	7,331
United Verde Extension	1,813	1,933	1,698	1,930	1,633	1,624
Utah Copper	†27,786	.....	.....	†27,810	.....	.....
Tennessee Copper	412	552	594	617	510	514

Foreign

Andes Copper Mining Co.	2,367	2,367	2,367	2,367	.....	.....
Braden	8,991	9,343	9,354	9,348	.....	.....
Boleo, Mexico	852	990	990	1,001	1,068	1,262
Bwana M'Kubwa	336	496	447	554	677	.....
Chile	8,934	8,954	8,960	8,972	.....	.....
Furukawa, Japan	1,549	1,501	1,649	1,563	.....	.....
Granby Cons., Canada	2,268	2,550	2,208	1,936	2,305	2,155
Mount Lyell, Aust	†1,515	.....	.....	†2,064	.....	.....
Sumitomo, Japan	760	1,608	1,317	1,412	1,317	.....
Union Miniere, Africa	9,075	10,230	10,890	10,803	10,390	9,590

†Three months. *Includes Arizona Commercial
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1926		1927		1928	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	71,026	2,291	76,198	2,458	68,469	2,209
February	68,131	2,433	69,202	2,472	67,423	2,325
March	75,728	2,443	69,314	2,236	.....	.....
April	73,454	2,448	71,122	2,371	.....	.....
May	73,542	2,372	71,613	2,310	.....	.....
June	71,317	2,377	69,539	2,318	.....	.....
July	72,228	2,330	65,545	2,114	.....	.....
August	72,014	2,323	67,248	2,169	.....	.....
September	72,672	2,421	65,936	2,198	.....	.....
October	75,099	2,423	68,595	2,225	.....	.....
November	74,947	2,498	68,080	2,269	.....	.....
December	72,205	2,329	67,377	2,173	.....	.....
Total	872,509	.....	829,878	.....	135,892	.....
Monthly average	72,709	.....	69,165	.....	67,946	.....
Average of daily rate	.....	2,390	.....	2,274	.....	2,265

Mining Stocks—Week Ended March 31, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	63⅜	55	61	Ap.14, My.20 Q	0.75
Arcadian Consol	Boston	...	...	5½		
Ariz. Com'l	Boston	4¼	4	4¼	Ja. 19, Ja. 31	0.25
Cal. & Ariz	New York	108½	98	103½		
Calumet & Hecla	Boston	22	20½	21½	No.30, De.15 Q	0.50
Cerro de Pasco	New York	67⅞	64⅜	67	Ja.12, Fe.8 Q	1.00
Chile Copper	New York	41½	38⅜	40⅜	Ma. 2, Ma.30 Q	0.26
Con. Copper mines	N. Y. Curb	11⅛	9⅜	11⅛		
Copper Range	Boston	16⅜	14⅜	16⅛	Ap.2, Ma.2, A	1.00
Crystal Copper	Boston Curb	*80	*56	*71		
East Butte	Boston	2	1⅞	1⅞	Dec., 1919	0.50
Granby Consol	New York	50⅜	43⅞	50⅛	Ap.13, My.1 Q	1.00
Greene Cananea	New York	134½	121⅛	128⅛	Nov., 1920	0.50
Howe Sound	New York	55	47⅞	51⅛	Ma.31, Ap.16, Q	1.00
Inspiration Consol	New York	21⅛	18⅞	20⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	...	...	3⅛		
Isle Royale	Boston	14	12⅛	14	Fe.28, Ma.15	0.50
Kennecott	New York	87	82½	86	De.2, Ja.3 Q	1.25
Magma Copper	New York	51⅛	48	51⅛	Ma.31, Ap.16 Q	0.75
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅜		
Miami Copper	New York	19½	18⅛	19	Fe.1, Fe.15, Q	0.37½
Mohawk	Boston	53½	50⅛	53⅛	Ja.28, Ma.1 Q	1.00
Montana-Idaho	Spokane	*50½	*46	*50⅛		
Mother Lode Coal	New York	3½	3	3⅛	De.16, De.31	0.25
Nevada Consol	New York	22	19⅛	21⅛	Ma.16, Ma.31 Q	0.374
New Cornelia	Boston	27⅛	16⅜	17⅛	Fe.3, Fe.20 Q	0.50
Noranda	N. Y. Curb	18⅛	17⅛	17⅛		
North Butte	Boston	1⅛	*99	1 1/16	Oct., 1928	0.25
Ohio Copper	N. Y. Curb	*90	*76	*82	Sept., 1926	0.03
Old Dominion	Boston	10	9⅛	10	Dec., 1928	1.00
Phelps Dodge	N. Y. Curb	128⅜	122	128	De.17, Ja.3 Q	1.50
Quincy	Boston	13⅜	12⅛	13⅛	March, 1920	1.00
St. Mary's Min. Ld	Boston	27	21⅛	26⅛	Fe.10, Ma.10	2.00
Seneca Copper	New York	2⅛	2⅛	2⅛		
Shattuck-Denn	N. Y. Curb	15⅞	14⅜	15		
Tenn. C. & C	New York	11⅛	10⅜	11⅛	Fe.29, My.15,Q	0.12½
United Verde Ex	N. Y. Curb	20⅛	19⅛	20	Ap.6, My.1, Q	0.50
Utah Copper	New York	146	141	146	Ma.16, Ma.31 Q	0.50
Utah Metal & T	Boston	1⅜	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	77*	*74	*77		
NICKEL-COPPER						
Internat. Nickel	New York	98¼	90	94½	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd	New York	...	...	112	Fe.17, Ma.1 Q	0.62½
LEAD						
Gladstone Mtn	Spokane	*9	*8⅛	*8⅜	June, 1927	0.005
National Lead	New York	135⅞	129	133	Ma.16, Ma.31Q	1.25
National Lead pfd	New York	147	144	147	Ap.23, Ma.1 Q	1.50
National Lead,pfd. B	New York	121⅛	117⅛	120		
St. Joseph Lead	New York	40⅞	38	39⅛	Ma.9, Ma.20,QX	0.75
ZINC						
Am. Z. L. & S	New York	22⅞	18⅜	21⅛	May, 1917	1.00
Am. Z. L. & S. pfd	New York	86	79	83⅛	Nov., 1920	1.50
Butte C. & Z	New York	6	5⅜	6	De.9, De.24	0.50
Butte & Superior	New York	10⅜	10	10⅛	De.16, De.31 Q	0.50
Callahan Zn-Ld	New York	2⅛	2	2	Ma.14, Ma.31	0.50
Consol.Lead&Zinc 'A'	St. Louis	14	12	14	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	18⅞	16⅜	18⅜	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	102	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	199⅛	195	198	Ap.20, My.10	2.00
Treadwell-Yukon	Toronto	27	26	26⅛		
United Zinc	N. Y. Curb	...	...	25		
Yellow Pine	Los Angeles	...	...	*25	Dec., 1925 Q	0.04
GOLD						
Alaska Juneau	New York	3⅜	3⅛	3⅜		
Argonaut	Toronto	*19	*16	*18½		
Barry-Hollinger	Toronto	1.25	1.16	1.24		
Central Manitoba	Toronto	1.51	1.26	1.47		
Con.W.Dome L. new	Toronto	*12½	*10	*10½		
Cresson Consol. G	N. Y. Curb	2 1/16	1⅞	1⅞	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	11⅛	10⅜	11	Ma.31, Ap.20 Q	0.25
Golden Cycle	Colo.Springs	†1.75	†1.74	....	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*25	*21½	*22½		
Hollinger Consol	Toronto	17.25	16.50	16.71	Ap.4, Ap.21	0.10
Homestake Mining	New York	73½	73½	73½	Ma.20, Ma.26 Q	0.50
Kirkland Lake	Toronto	2.14	2.00	2.05		
Lake Shore	Toronto	24.25	23.75	24.00	Ma.1, Ma.15QX	0.20
McIntyre-Porcupine	New York	26½	26½	26½	Fe.1, Ma.1 Q	0.25
Portland	Colo.Springs	†*25	†*22	...	Ap.6, Ap.15 Q	0.02
Rand Mines	New York	...	...	40⅜	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.30	3.10	3.30		
Teck-Hughes	Toronto	8.70	8.35	8.50	Fe. 1, X	0.15
Tom Reed	Los Angeles	*33	*31	*31	Dec., 1926	0.02
Tough-Oakes	Toronto	*56	*52	*56		
United Eastern	N. Y. Curb	...	...	*58	July, 1924	0.05
Vipond Cons	Toronto	*92	*73	*78	Ap.1, Ap.15	0.03
Wright-Hargreaves	Toronto	5.05	4.50	4.70	Ap.13, My.1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	26⅜	24⅛	25⅛		
Con. Cortez	N. Y. Curb	*24	*24	*24		
Dolores Esperanza	N. Y. Curb	...	...	*31	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	...	...	16⅜		
Premier Gold	N. Y. Curb	3⅛	2⅜	2 1/16	Ma.15, Ap.4	0.08
Tonopah Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*15	*12	*12	Ma.1, Ap.21	0.07½
Tonopah Mining	N. Y. Curb	4⅛	4 1/16	4⅛	Mar.,31 Ap. 21	0.07½
West End Consol	N. Y. Curb	...	...	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*99	*49	*92	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.70	1.52	1.64	May, 1920	0.03
Castle-Trethewey	Toronto	*61	*57½	*60		
Coniagas	Toronto	5.00	4.85	5.00	May, 1924	0.12½
Keeley	Toronto	*66	*60	*66	Ma.1, Ma.15	0.04
Lorrain Trout Lake	Toronto	...	...	*30	July, 1925	0.05
Mining Corp. Can	Toronto	3.60	3.30	3.35	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb	4⅞	4⅜	4⅛	Ma.31, Ap.20Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5⅛	4⅜	5⅛	Ma.25, Ap.4QX	0.12½
Bingham Mines	Boston	51	51	51	Ma.22, Ap.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb	145	143	143	Fe.29, Ma.5QX	0.75
Cardiff M. & M	Salt Lake	*84	*69	*84	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.00	3.67½	3.97½	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g.	Spokane	*24	*15	*24		
Erupcion	Boston Curb	*30	*28	*30	Ap. Q	0.07½
Eureka Lily	Salt Lake	1.87½	1.80	1.85		
Federal M. & S	New York	138	138	138	Jn.25, Jn.29 Spec.	$10
Federal M. & S. pfd	New York	95	94⅜	94⅜	Fe.24, Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	16⅜	15⅜	16⅜	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*14	*13	*13		
Iron King Mining	Salt Lake	*61	*60	*61		
Keystone Mining	Salt Lake	...	...	*35	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*40	*38	*30		
Lucky Tiger-Com	KansasCity	†7.95	†7.80	...	Ma.10, Ma.20X	0.07
Mammoth Mining	Salt Lake	1.60	1.60	1.60	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	6.35	6.10	6.35		
Park Utah	New York	12⅛	10⅜	11⅜	Ma.15, Ap.15 Q	0.20
Plutus Mining	Salt Lake	...	...	*25	Oc.25, No.10 Q	0.10
Silver King Coal	Salt Lake	10.75	10.50	10.60	Ma.20, Ap.2	0.25
Silversmith	Spokane	*19½	*18	*18	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*46	*40	*46		
Sunshine M. Co	Spokane	1.50	1.25	1.50	Fe.10, Fe.20	0.02
Tamarack-Custer	Spokane	*90	*82½	*82½	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.50	13.00	13.50	Ma.21, Ma.29Q	0.30
Utah-Apex	Boston	4⅛	4	4⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	60⅜	58⅛	58⅞	Se. 2, Oc. 1.	1.75
Cleveland-Cliffs Iron	Cleveland	115	111	114†	Ja. 13, Ja. 25. Q	1.00
Colorado Fuel & Iron	New York	79⅞	75	76	May, 1921	0.75
Gt. North'n Iron Ore	New York	22¼	22⅛	22⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	53	50⅛	52	Fe. 15 Ma. 1 QX	0.66⅔
Republic I. & S	New York	61⅛	59⅛	60	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd	New York	110	109	110	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I	New York	133½	125⅛	129⅜	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd	New York	122⅜	120	122⅜	De. 20, Ja. 3 Q	1.75
U. S. Steel	New York	151⅞	146	147⅛	No. 30, De. 30 Q	1.75
U. S. Steel, pfd	New York	145⅜	145	145⅛	Oc. 30, No. 29 Q	1.75
Virginia I. C. & C	New York	32	32	32	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	60	60	60	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	...	...	27	Jn. 26, Jn. 30	1.45
So. Am. G. & P. New	N. Y. Curb	3⅛	3	3⅛		
Alum. Co. of Amer	N. Y. Curb	127½	125⅛	125⅛		
Alum. Co. of Amer. pf.	N. Y. Curb	109¼	108⅜	108⅜	Ma. 15, Ap. 1 Q	1.50
Vanadium Corp	New York	89⅛	81	86⅜	Fe. 1, Fe. 15 Q	0.75
Patino M. & E	New York	30⅜	25⅛	30	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp	Montreal	31	30	31	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	92½	92	92	Ma. 31, Ap. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	86¼	80¼	83	Ap.14, Ma.1QX	1.75
Texas Gulf	New York	79	74½	75⅜	Ma. 1, Ma. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	45¼	39	43⅜	Fe. 18, Ma. 1 Q	0.75
Amer. Metal, pfd	New York	125	121½	122½	Fe. 18, Ma. 1 Q	1.75
Amer. Sm. & Ref	New York	192⅜	181⅜	188⅜	De. 31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd	New York	140¼	139¼	140⅜	De. 31, Ma. 1 Q	1.75
Consol. M. & S	Montreal	279	274	275	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	174½	157⅛	171⅛	Ma.31, Ap.16 Q	1.00
U. S. Sm. R. & M	New York	43⅛	41⅛	43	Ap.5, Ap.14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	53¼	53	53¼	Ap.5, Ap.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED MARCH 20, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	62/6	60/4½	61/3	Feb., 1928	5 p.c. (†)	
Burma Corpn. (10 rupees)	13/4½	12/6	13/1½	Jan., 1928	6 annas*	
Bwana M'Kubwa (5s)	5/1½	4/3	5/—			
Camp Bird (2s)	5/4½	3/10½	5/3			
El Oro (£1)	4/6	4/—	4/3	Nov., 1924	2½ p.c.*	
Frontino & Bolivia (£1)	14/3	13/9	13/9	Jan., 1928	5 p.c.	
Mexican Corpn.(£1)	11/1†	9/3	10/3			
Mexico Mines of El Oro (£1)	32/6	28/9	31/3	Dec., 1926	3½ p.c.*	
Mond Nickel	185/—	148/1½	182/6	Feb., 1928	7½ p.c.	
N'Changa Copper Mining	10/—	9/6	10/—			
Oroville Dredging (£1)	4/—	3/7½	4/—	Dec., 1923	3½ p.c.	
Rhodesian Congo Border (£1)	20/—	17/6	22/—			
St. John del Rey (£1)	12/10½	12/—	12/6	May, 1927	3½ p.c.	
San Francisco Mines (10s)	27/9	26/10½	27/6	Jan., 1928	25s.	
Santa Gertrudis (£1)	16/10½	15/9	16/6	Jan., 1928	7½ p.c.	
Selukwe (2s. 6d.)	9/—	7/10½	8/10½	April, 1917	6¼ p.c.	
S. Amer. Copper (2s.)	1/7½	1/3	1/4½	Nov., 1917	75 p.c.	
Tanganyika (£1)	67/—	63/6	65/7½	Aug., 1927	7½ p.c.	
Union Miniere de Haut-Katanga (Brussels)	7830	7730	7787.50	July, 1927	182.60 (‡)	

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.